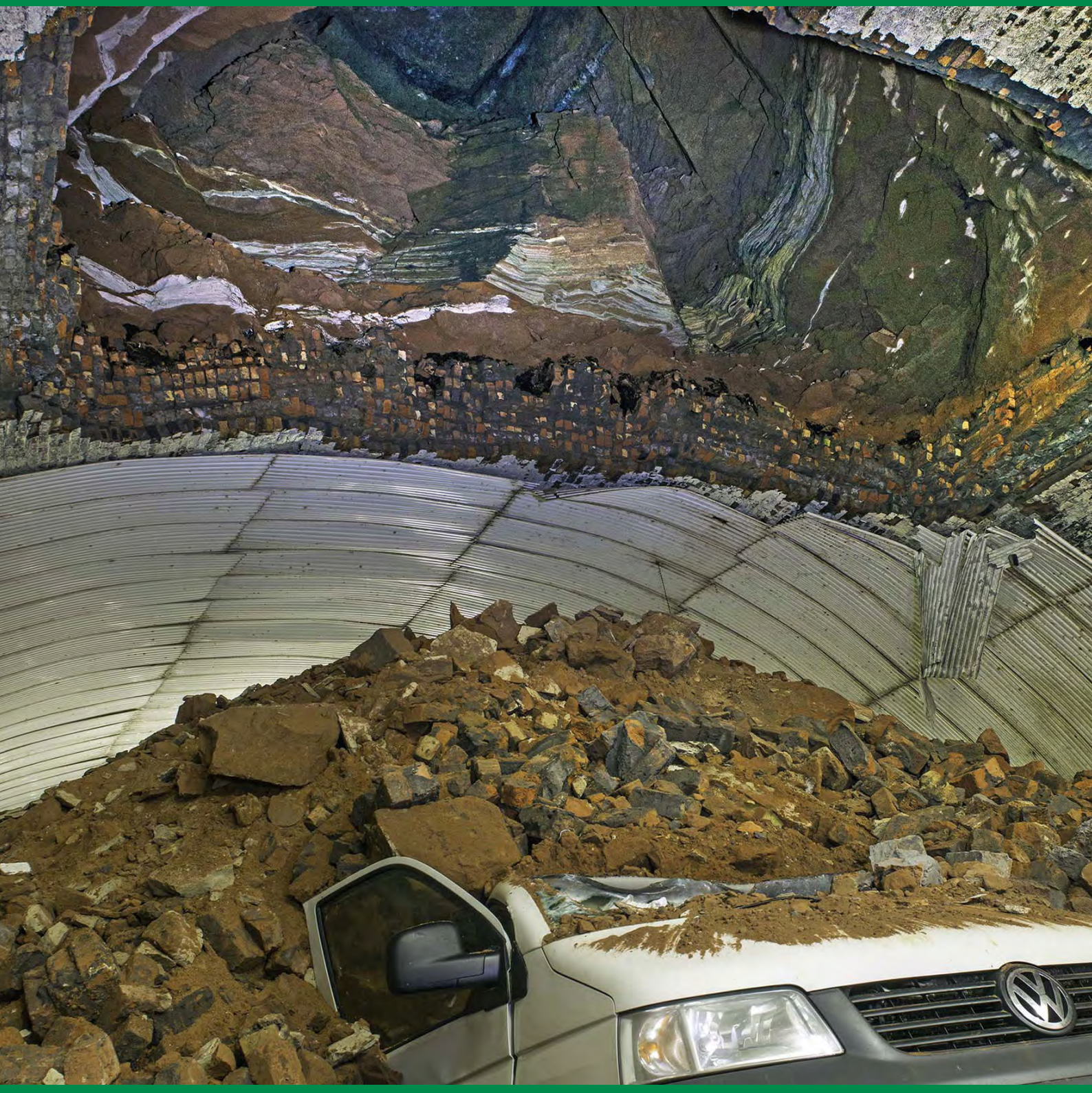
Subterranea

The Magazine for Subterranea Britannica



Subterranea Britannica **December 2015 Issue 40**

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ROC Group Controls
AUs in Northumberland
Silesia Weekend
Factory Air-Raid Shelters

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: Front Cover: The Dingle Tunnel collapse in Liverpool. A van lies totally crushed under the weight of the tunnel collapse. The material that had fallen into the Dingle station site is a mixture of stone, brick, earth and sand. This was the material that was used as part of the cut and cover method of construction that was used at the station. Photo Chris Isles

Back page upper: The Sub Brit party ready for their underground visit at Nowa Ruda coal mine through the 1890 adit. A small niche above the adit holds St Barbara – the Patron Saint of Miners. The helmet colours show we are a mix of technicians, supervisors and 'honey men' (see article for more details). Photo Chris Wilkins

Back page lower: The subway beneath Crystal Palace Parade in South London. The subway linked the High Level station which was on the north side of the Parade with the Crystal Palace on the south side. On the far side of the subway there is a courtyard from where steps led up to the Palace. This photograph required two separate exposures, one taken during daylight and the other at night. This allowed the shutter to be left open for several minutes to evenly illuminate the subway. The two were then combined to produce this image. Photo Nick Catford

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The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

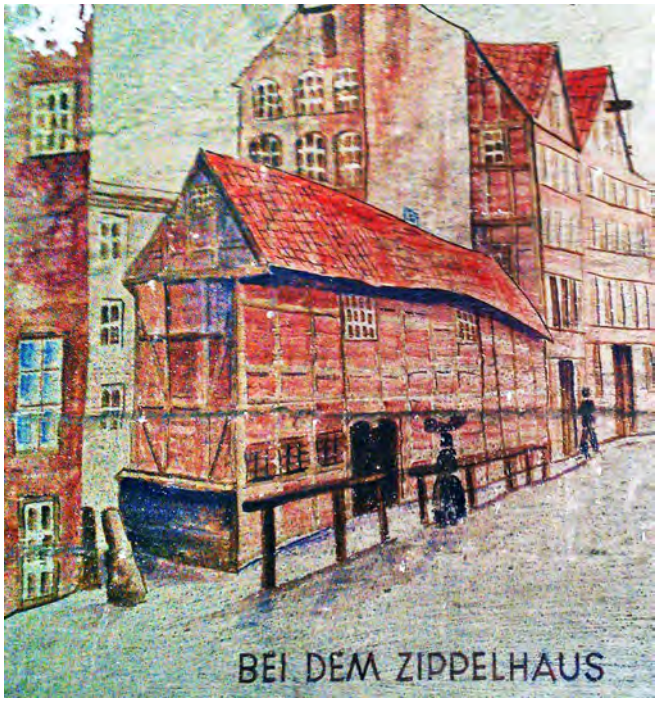
As an organisation that has over 1,100 members, it is inevitable that from time to time we hear the sad news that one of our members has died. It was, however, a real shock to many of us to learn of the tragic passing of Dom Jackson. Dom represented all that was best in Sub Brit – knowledgeable, energetic, approachable and with a great sense of humour to boot. A fuller appreciation appears later in this edition but I know Dom's family was comforted by the huge turn-out at his funeral, including around a couple of dozen Sub Brit members. I had the privilege of saying a few words at the funeral and like many of you will greatly miss his company and friendship at events and on visits.

On a cheerier note, most of you will recall that Subterranea Britannica celebrated its 40th birthday last year. Well now it's the turn of *Subterranea* which has reached its 40th edition too. The magazine is a frequent source of compliments and compares well against many commercially produced publications. We owe a vote of thanks to Nick Catford our Editor and the rest of the team that work on it. This includes of course our authors and photographers but also sub-editors (Linda Dixon and myself), plan drawer Tim Robinson, layout artist Martin Snow and proof-reader Stewart Wild. Plus of course our printers at Hierographics and our distribution house Martell Mailing. The magazine has grown in both quality and size over the years and although we will continue to look to put content online I see the hard-copy magazine continuing for many years to come.

As we approach the year end, the grants and donations that Sub Brit has been able to make look like reaching a record figure. When we were granted gift-aid status, the Committee took the view that we should use this 'bonus' funding to support underground-related projects that are helping to preserve, interpret or restore our heritage rather than to subsidise membership fees. This year we have supported projects from Dundee to Dover. Sites helped range from 19th-century stone mines to Cold War bunkers. In some cases we have provided support to local societies for items such as surveying equipment or gas-monitoring meters. Subterranea Britannica has never tried to have the monopoly on underground research and exploration and has a long track-record of working with other local or specialist groups; long may it continue.

Finally as the year draws to close, I hope you've managed to visit some underground sites on your own personal wish list. Personally I particularly enjoyed the Sub Brit weekend in Hamburg. Relationships with our continental neighbours are a great Sub Brit strength and longer trips are always a great way to get to know fellow members better. The day of visits to RAF Daws Hill was also a highlight (or should that be lowlight!). Thanks to all members who have arranged or helped with visits throughout the year; just as one picture is worth a thousand words, one visit is worth a thousand pictures. One of the great pluses of underground exploration is that the list of potential sites grows daily! Crossrail, Metro systems, sewers and mines continue to chip away at our bedrock and to provide potential venues for future visits.

With seasonal greetings to all and good health and fortune in 2016.



One of the fine murals in the Eidelstedter Weg bunker in Hamburg showing a scene in the dock area of the city. Photo Martin Dixon

chairman@subbrit.org.uk

Martin Dixon addressing the VIP group prior to leading them through the bunker at Daws Hill in July 2015. Photo Clive Penfold

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events

Sub Brit specific events

2016

16 January SB Committee meeting
1 March Copy deadline for *Subterranea* 41
End of April *Subterranea* 41 published
23 April SB AGM & Spring Meeting, London
6 - 9 May SB Rome Weekend
25 June SB Committee meeting
17 September Paddock open day
15 October SB Autumn Meeting (venue tba)

Other underground-related events

2016

29 - 30 January London Transport Museum Acton Depot Tour
26 - 27 February London Transport Museum Acton Depot Tour
23 April SERIAC conference, Kingston, Surrey
29 April - 2 May Railway & Canal Historical Society visits, Croydon
7 - 14 May Fortress Study Group, Mallorca & Menorca Tour
May (tbc) Reigate Caves public open day
17 - 19 June NAMHO Conference, Dublin
13 - 20 August EuroSpeleo, Yorkshire Dales
8 - 11 September Heritage Open Days, England
12 - 18 September Doors Open Days, Scotland
17 - 18 September London Open House
September (tbc) Open Doors, Wales - Every weekend in September - programme available August 2016
September (tbc) European Heritage Open Days, Northern Ireland

2017

6 - 10 March Hypogea, Cappadocia

For web links to these events please visit www.subbrit.org.uk/events
or contact the Society concerned

If you know of other relevant events run by other societies, please let us know so that they can be advertised in the next edition and on the website

Dom Jackson Appreciation from Martin Dixon

2 March 1974 – 3 October 2015

Dom Jackson, born in the year that Sub Brit was founded, richly deserved to enjoy his membership for many years to come. Tragically however he died in October after a stroke suffered at the end of August. He spent the period in between receiving the best treatment possible at Southmead Hospital in Bristol but sadly slipped into a coma from which he never recovered.

Photo Andy Collins

His funeral later in October was a celebration of his life and the turnout was so large that even with the chapel aisles full of people standing there wasn't room for everyone and some had to follow the service from the corridor outside. I know that this amazing turnout was a great comfort to Dom's family who could see for themselves the positive impact he had had on so many.

We learnt that Dom's practical skills started in childhood – his first word was 'screwdriver'! Dom's love of the outdoor also started at an early age – family holidays were usually spent camping and he progressed through Cub Scout, Scout, and Venture Scout to become a Scout Leader. Giving something back in this way was so typical of Dom – always looking to help others and to contribute to helping build a sense of value and belonging.

He was due to descend Gaping Ghyll just after he fell ill - unusual as Dom didn't usually include caves in his interests. However, as he said, if he was going to do one it may as well be a big one! I was privileged to say a few words at the funeral and I've reproduced them below as a tribute to someone who represented Sub Brit membership at its very best.

"Everyone has a different attitude to life.

Some people take, some people talk and others act – Dom was a man of action. I first met Dom shortly after he joined Subterranea Britannica in 1999 and from then onwards he was a committed, knowledgeable and energetic member and a firm friend. I know this experience was mirrored in many other groups and communities that Dom was involved with, from scouting to drag racing.

He contributed to our magazine, attended and organised visits in the UK and overseas, spoke at meetings and was active in site restoration. One of Dom's great passions was for old mines – especially the Bath Stone mines of Wiltshire and the slate mines of north Wales. He would willingly guide enthusiasts round these often complex sites – happy to help others share his enjoyment rather than merely extending his own personal 'tally'.

He became an expert on the Bath Stone mines, including their re-use in various forms during World War II. When he was lucky enough to get access to the former Government Headquarters in Spring Quarry beneath Corsham he then put a presentation together so that those less fortunate could at least enjoy the visit second hand.

A perfect example of Dom's personality was when we once 'temporarily mislaid' one of our members at Swan Mine. Dom immediately leapt into action, leading the search party, quickly locating the person and resolving the issue. Our lost member got away with a caution as it was just a 'miner' offence. Dom was booked to attend September's Sub Brit trip to Cotswold stone mines and

Dom and Mole. photo Jane Ware

in typical fashion had volunteered to help with transport in his trusty Land Rover. Sadly it was not to be.

He was particularly involved with work at the former Radar bunker at Wartling in East Sussex – a mere 350 mile round trip from Cheltenham on every occasion! Whatever he did he was 'hands on' – keen to make a difference and to pass on his knowledge, skills and enthusiasm to others. He particularly enjoyed excavating and progressed to "digger driver, third class".

John Smiles, who leads the work at Wartling, recalls: 'Dom was at the very heart of our core team, and was the perfect bloke to hand a digging bar to and say "make a hole in that mate" knowing it would be open when you got back. Most of all, Dom was just a happy addition to our crew. Whether up to his waist in bunker slime, or sharing a joke in the pub in the evening. We really missed him on our last workday when we pumped the bunker dry enough to see the plant room sump exposed for the first time in about forty years. I really wish he'd been there to see it. We all do.'

Dom worked for Schindlers Lifts – a career where he experienced more than his fair share of ups and downs. It was perhaps a fitting career for someone so interested in what lies underground. By rights he should now be ascending to the highest level possible. In Dom's case, however, I suspect he'd be equally happy with a long descent deep below the earth where he can continue to indulge his passion for the wonders that lie beneath our feet.

Photo Robin Ware

Dom was instrumental in getting a memorial stone installed underground for his great friend Eric Burke (better known as 'Mole') who died in 2005. It reads: 'It's better to walk with a friend in the dark than walk alone in the light'.

In Sub Brit and in other exploration and activity groups he was involved with, Dom made many friends and no enemies. Many of those friends are here today to pay tribute and say good bye to a wonderful person.

Dom will be missed but never forgotten."

Julian Allason

14 May 1948 – 3 October 2015

Subterranea Britannica member Julian Allason has sadly died following heart surgery on 3 October – a black day for Sub Brit as it also marked the day of Dom Jackson's passing. Julian had a varied career which included photographer, disc jockey, computer programmer, magistrate and travel writer. The last served Sub Brit particularly well as he often wrote pieces for *Subterranea* whenever his travels took him into underground structures.

Topics and sites he wrote about ranged from the Amsterdam Metro to submarine bases in Balaclava and from the Cabinet War Rooms to Cappadocia. His articles were always clear and concise with information sources for those who wanted to follow up or find out more. His most recent article appears on page 50 of this journal.

His love of underground space was catalysed during family holidays when he sought out World War II bunkers on the Isle of Wight and elsewhere with his brother Rupert (who came on a Sub Brit trip to Germany and is better known as author Nigel West). This interest stayed with him and he later drove round the UK looking for Cold War RSGs (Regional Seats of Government).

In the 1960s he drove round in a psychedelically coloured Mini and as a journalist interviewed Brigitte Bardot and Omar Sharif. His computing interest was triggered by the release of the Commodore PET but he never took computing or any other of his interests too seriously. He once wrote a software programme that predicted the current location of Lord Lucan!

Julian is survived by his wife Dr Sarah King with two sons, plus two sons and a daughter from a previous marriage. We offer our sympathy to all.

News

Miscellany compiled by Nick Catford & Paul Sowan

NEWS – ARCHAEOLOGY

Human fossil found in Arago Cave, Tautevel, France

A student assisting at an archaeological excavation in Arago Cave, near Tautevel in southwest France, has discovered a 550,000 to 560,000-year-old adult human tooth. Valentin Loescher, aged 20, and his friend Camille Jacquey were volunteer diggers, and are thought to have found the oldest known ancestor of modern man to come to light in France. It is some 100,000 years older than 'Tautevel Man' found at the same location in 1971.

SOURCE: CHRISAFIS, Angelique, 2015, France: human tooth unearthed from 560,000 years ago. *The Guardian*, 29 July 2015

Another 'red lady' found in a cave, northern Spain

The original 'red lady' of Paviland was what turned out to be, on inspection, an ochre-covered skeleton of a man found in a limestone cave in the Gower peninsula in south Wales. It was found in 1823, and has been dated to 33,000 years old. The red ochre staining on the bones was interpreted as part of a burial ritual. Now another such human skeleton, which really is a female, has come to light in the El Mirón cave in northern Spain. The remains have been chewed by animals, and the cranium is missing, and has been dated to 18,700 years old. The red ochre colouring to the bones is, reportedly, not of local origin, and associated pollen suggests that the deceased lady was buried with flowers. This is thought to have been a high status person.

SOURCE: ANON, 2015, Another red lady. *Descent* 244

Roman vaults under a Norman castle, Colchester, Essex

Members of the Royal Archaeological Institute met at Colchester Castle on 8 March 2015. The published report of the event contains some information on the capacious vaults in the Roman foundations, windowless spaces as worthy of Subterranea Britannica's attention as any of the surface-built Cold War bunkers so much visited by our members.

The castle is thought to have been built in the 1070s or 1080s on the site of an earlier Roman temple of c. AD 54. For some reason, at a date unspecified in the report, the vaults were filled with sand, a presumably somewhat laborious process, especially as the town stands on the top of a hill. The masonry is a mixture of Roman tile and *septaria* (hard calcareous clay nodules from the London Clay) with lime mortar.

In the late seventeenth century one John Wheeler broke through into the vaults whilst attempting (unsuccessfully) to demolish the whole castle. Much of the sand, again laboriously, was removed at about that time. In 1860 the spaces were opened as a quasi-subterranean public museum. In 1919 the Roman age of the foundations was established, and in 1920 the ownership of the structure was transferred to the Borough of Colchester.

Steps down to the Roman vault and air-raid shelter at Colchester Castle. Photo Claire Parfrey

The Castle walls – which are up to 30 feet thick – offered solid protection and following a visit by Colchester's Air Raid Precautions (ARP) officer on 25 August 1939, work to convert the vaults into a shelter was begun immediately. The air-raid shelter was sufficient for 150 people but had very basic amenities, little more than seats and a toilet; it was rather an uncomfortable and unpleasant place to spend the night. The museum attendants became responsible for opening the vaults to the public during air raids and were sworn in as special constables to undertake their duties. The castle remains as a public museum in the twenty-first century.

SOURCE: HAES, Julia, 2015, Report of the spring day meeting at Colchester Castle Museum, 8 March 2015. *Newsletter Royal Archaeological Institute* 50 (August 2015). Also E J Rudsdale's diaries of life on the home front in Britain during the Second World War.

The sad fate of a medieval undercroft at Croydon, Surrey

Probably at least as many historic buildings in Croydon have been destroyed or allowed to be destroyed by local owners and Croydon Council in the last hundred years or so as were blown to pieces by enemy bombing in

both World Wars. Early in the nineteenth century parts of Croydon Palace were pulled down (to make way for a pioneering horse-drawn railway in 1805) or fell down, although the chapel and great hall and adjoining buildings survive, now in use as a private girls' school.

In the 1890s the High Street was widened and several streets of ancient timber-framed houses demolished to allow road widening and to make way for the town's first generation of electric trams. And in the 1920s a proposal to knock down the Whitgift Almshouses, built about 1600, was fortunately defeated. In the second half of the twentieth century both the Davis Theatre and the Grand Theatre were demolished to make way for office blocks.

Between the High Street and the Palace grounds lies Surrey Street, home to a street market at least since the 1400s. On the west side of Surrey Street part of a narrow road called Overton's Yard collapsed in or about 1877 into a stone-vaulted medieval cellar. In a less philistine town than Croydon, this would have been carefully investigated, recorded and preserved. But Croydon's response was simply to fill up the void and repair the road over the top. A very similar undercroft in West Street, Reigate, has been preserved, Scheduled as an Ancient Monument, and is still accessible.

An anonymously written local newspaper article in 1898 included a sketch of the Reigate stone vaulting in the Croydon cellar, and suggested it was the basement of a substantial house occupied by the Reeve of Croydon, a man named Adam Bochers, in the years 1399–1400.

The undercroft in West Street, Reigate. Photo Ian Capper

Seventy or more years later part of this vault was rediscovered, and destroyed, by a modern telephone company making a trench for their cables. Fortunately, local archaeologists from the Croydon Natural History & Scientific Society were able to make a measured drawing, and retrieve some large pieces of Reigate stone masonry. These shaped pieces of cut stone from the vault are now on loan to the Wealden Cave and Mine Society and on display in Reigate's Tunnel Road East 'caves'.

Numbers 20–24 Surrey Street are four adjoining shop units within a substantial three-storey nineteenth-century building, standing between Overton's Yard and the Dog & Bull public house. As the undercroft evidently lay below the yard and at least two modern shop units, it would appear to have been quite a large space. Possibly, some of this structure remains undamaged below parts of nos. 20 or 21.

SOURCE: ANON, 1898, Facts and conjectures concerning some architectural remains at Nos. 20, 21, etc., Surrey Street, Croydon. *Croydon Advertiser*, 14 September 1898.

Sinkhole investigations at Dorking, Surrey

Wealden Cave and Mine Society members have responded to a message from a resident of Dorking concerning a mysterious collapse in a garden behind a 19th-century house. Members descended by wire caving ladder, and tested the air quality underground, which was found to be good. A short stretch of mined tunnel, about five feet wide and ten feet high in the Hythe Beds sand, was explored and photographed, and pick-marks on the walls noted. This runs straight for 15 or 20 feet, then continues on a different alignment beyond a dog-leg to a collapse. No mined entrance has been located, so it is considered that the tunnel extends, possibly in both directions, beyond the collapses. The dog-leg may be the result of attempting to keep the mine within a property boundary, or may be the result of two independent mines accidentally meeting.

The dog-leg. Photo Andy Belcher

Peter Burgess suggests the mine was for building-sand, so quite unlike in purpose tunnellings for glass-sand well-known in the stratigraphically higher Folkestone Sand prevalent in Dorking, Reigate and Godstone further east. It is hoped to by-pass roof-fall blockages in due course, as it seems likely that this small mine may extend under neighbouring property, as a small collapse was recorded nearby in 1982.

SOURCE: BELCHER, Andy, 2015, Clifton Terrace sinkhole investigation. *News of the Weald* 95 (August 2015).

Possible new species of human reported from Rising Star Cave, South Africa

A 'huge haul of bones' found in a remote part of the Rising Star Cave, 50 kms east of Johannesburg, may represent the remains of a hitherto unknown species provisionally named *Homo naledi*. Or they may be

the already-known species *Homo erectus*. To reach the subterranean find site it is necessary to crawl through crevices 25 cm (10 inches) high and 20 cm (eight inches) wide: six 'lightly built female researchers' were brought in to excavate the remains, which are about 100 metres in from the entrance, and 40 metres below ground level.

Unfortunately the earth in which the bones are found has been disturbed by previous modern cavers, making stratigraphic dating unreliable. More than 1,500 bone fragments represent at least fifteen individuals, including infants, juveniles, and one very old adult. Thousands more fragments have yet to be excavated. They have not yet been dated. Experts are still debating whether these remains are of a new species, or represent *Homo erectus*, a forerunner of modern man, *Homo sapiens*, flourishing around 1.5 million years ago.

These newly found prehistoric ancestors are described as long-legged, gangly, with tiny brains. How very young and very old persons reached this very awkwardly accessible place, in pitch darkness, is a puzzle. One theory is that this was in effect a burial site, the individuals having died, their corpses being 'posted' through the final very narrow and steeply downwards-sloping passage: children who had died young, and people in old age, seem to fit the bill. Destructive testing will be needed to date the bone fragments, and will be delayed until all other studies have been concluded.

SOURCE: SAMPLE, Ian, 2015, A star is born: bones may be from new species of human. *The Guardian*, 11 September 2015

NEWS – CONSERVATION & HERITAGE

News from the glass-sand mines, or 'caves', at Reigate, Surrey

The Wealden Cave & Mine Society's five 2015 public open days at Reigate 'caves' have been astonishingly popular, with the guides working almost non-stop taking groups around Tunnel Road West and the far older Barons' Cave under the nearby castle earthworks. Next year's 2016 'cave days' are expected to be the first Saturdays in May to September.

Elsewhere in the town the smaller mine underneath the former Nutley Hall public house is still accessible to WCMS members, courtesy of residents in the building which has been converted to residential use. A large volume of modern rubbish which had been dumped down the shaft over the years has now been removed, with no doubt a careful watch kept for older mine-related artefacts.

SOURCE: BURGESS, Peter M., 2015, Surrey news. *News of the Weald* 95 (August 2015)

Reviving Alderney's fortifications, Channel Islands

Members who have visited Alderney will recall unrestricted access to many but not all of the extraordinary number and range of above-ground and underground military works on this very small island, and also their neglected state. They will probably also remember Trevor Davenport, the local authority on the island's military history, and his assistance with gaining access to sites not freely accessible.

Trevor has now written a paper, published in the latest issue of the Fortress Study Group's journal, in which he reviews Alderney's defence works from the Roman period through to modern times, the most obvious of which are the Victorian English and World War II German structures and tunnels. The historically important fortifications dating to the years of the French Revolution and the Napoleonic Wars are now difficult to recognise, having been dismantled or built over by the Victorians.

Contrastingly, during the German occupation it is starkly clear where Nazi reinforced concrete additions have been added to older English stone buildings. The author states that Alderney possesses one of the finest concentrations of mid-nineteenth and mid-twentieth-century examples of military architecture in northwest Europe. Regrettably, he says, these are located on 'a tiny island with a population of less than 2,000 inhabitants isolated in the Channel'.

With such a small population, only a fraction of whom one can imagine view the defence works as anything more than eyesores, and a small seasonal tourist trade about which much the same is probably true, it is not surprising that the buildings and tunnels are neglected. The States of Alderney own the three largest forts and two of the smaller ones, but lack sufficient public funds to maintain them. The Landmark Trust owns and has restored Fort Clonque, which two Subterranea Britannica groups have rented for visits in recent years, but so far as the general public is concerned, this can only be viewed from the outside.

Fort Tourgis. Photo Nick Catford

From 2014 onwards groups of twelve to twenty local volunteers have been, with some official support, 'tidying up' a number of sites, clearing earth and vegetation and modern rubbish and so making them more readily accessible and understandable. The local government (the States of Alderney) 'assists when and how it can' with labour and equipment. And the Fortress Study Group has sponsored some twenty interpretation boards

at Fort Tourgis, a massive ruin near Bray Harbour. Greatly improved public access at about half a dozen sites is the result to date, and is described and illustrated with around fifty photographs. Readers are referred to www.alderneylivingislands.com

SOURCE: DAVENPORT, Trevor, 2015, Reviving Alderney's fortifications. *Fort* 43

NEWS – HEALTH & SAFETY

Cave rescue events report for 2014

The British Cave Rescue Council has reported on nine 'underground incidents' in the British Isles in 2014, and 62 surface incidents. One underground fatality and four cases of injury are included. The death was of a cave diver fatally overcome by gas or foul air beyond a sumped part of the Aber Las / Cambrian slate mine near Llangollen, Wales: the North Wales CRO gave 19 hours of their time responding to this incident. A number of occasions reported are of instances where a Cave Rescue Organisation has been called in to help find missing persons, dogs lost down mine shafts, etc.

The underground incidents other than in natural caves, of primary interest to Subterranea Britannica members, were as follows:

- Swimbridge, Barnstable: Devon CRO assisted authorities looking for a missing man (55) by descending and checking a mine shaft and helping with a surface search [Seven hours]
- Windegg mine caverns, Arkengarthdale: One person slipped and became trapped, sustaining bruising [Four hours]
- Devonshire Cavern (mine), Matlock, Derbyshire: A novice female caver in her 30s fell seven metres while climbing a rift under instruction some way into the mine, resulting in a broken ankle [Five hours 5 minutes]
- Old iron mine (Simonsbath), Exmoor, Devon: Authorities were assisted searching the mine where a walker had reported shoes and socks left outside. All that was found underground was a 'geocaching' site [Four hours]
- Gentlewoman's Shaft, Masson Hill (Matlock), Derbyshire: A party of four men on an intended one-way through trip down the shaft and out via Youd's Level failed to find their way to the lower-level intended exit. They returned to the bottom of the shaft, but not having the appropriate equipment and skills to climb out had to be hauled to surface when reports of their being overdue reached the Derbyshire CRO [Eight hours 10 minutes]
- East Crinis mine (near Par), Cornwall: Three men were overdue, trapped in the entrance adit at beach level by high tide. They were able to exit before the Devon CRO search commenced [One hour 50 minutes]
- Scotland Street abandoned rail tunnel, Edinburgh: Scottish CRO were called out to ensure all of a group of 30 to 40 'urban explorers' had departed before the entrance was re-secured [Two hours]
- Hilton mines, Scordale: Two men aged 66 and 67, reported overdue, were met by the rescue team safe and well on the surface path to the entrance [15 minutes]
- Rampgill mine, Nenthead: a group of three persons trapped by a rock-fall were dug out by a COMRU team member and his companion who happened to be in the mine [Four hours 30 minutes]
- Ethiopia: two Gloucestershire CRO members who happened to be caving in Africa were asked to look for a missing person who might have gone underground. Very low oxygen levels prevented a full search, and the person, who was not found, was presumed dead [Two days]
- Owlacombe mine, Ashburton, Devon: Devon CRO responded to a request for assistance to find a missing person and inspected numerous open mine shafts [Five hours 4 minutes]
- Long Meg mine, Little Salkeld: COMRU searched a number of mines for a missing male [1 hour 30 minutes]

The time devoted to the Cave Rescue Organisation teams in each incident is given in brackets. Remember, anybody can twist an ankle in the comfort of their own home. If you do that underground, it can make it very difficult, painful, or impossible for you to get out. And if nobody on the surface knows where you are, and at what time are expected to exit, you may have a very long cold wait in the dark before a cave rescue team finds you!

The caving magazine *Descent* has published detailed BCRC rescue reports since 1994. They can be traced online by searching for BCRC in the author index at www.wildplaces.co.uk See also www.caverescue.org.uk

SOURCE: BRITISH CAVE RESCUE COUNCIL, 2015, The rescues of 2014. *Descent* 244, 26–28.

NEWS – MILITARY & DEFENCE

Inverbervie R1 ROTOR complex sold

Although built as a single-level bunker part of the bunker was converted to two levels during a refit for the US navy by removing the original teak floor which was raised four feet above the actual floor to create a cableway.
Photo Nick Catford

The former RAF Inverbervie CEW ROTOR Radar Station and AFHQ in Aberdeenshire has been bought by a Subbrit member. The new owner, who is a historian, plans to use the guardhouse as a private residence, and to preserve the underground operations block and record the site's history. Inverbervie was constructed as part of the first phase of Operation ROTOR between 1951-3, and codenamed site 'LGZ'. Architecturally, the operations bunker is a type R1, as at Bempton, Cold Hesledon, Trimington, St Margarets, Beachy Head, Ventnor, and Portland, and the guardhouse is of the 'Stone' variant similar to those at Buchan, Anstruther, Crosslaw, and Boulmer. With the formation of No. 977 Signals Unit, RAF Inverbervie became operational as a Centimetric Early Warning station on 1 June 1953, parented by RAF Leuchars, and controlled operationally by Headquarters, Caledonian Sector at Barnton Quarry.

Between around 1968-78, Inverbervie was used as a US Naval oceanic monitoring station linked with RAF Edzell, and the US military retained a communications link station at Inverbervie until 1992. The bunker's present layout reflects its final military function from 1984-93 as the emergency AFHQ for the Scotland District, on standby to Craigiehall. In the event of nuclear conflict, Inverbervie was ready to provide accommodation for a full tri-service staff overseeing military units within the RGHQ area controlled by Anstruther and subsequently Cultybraggan. The site was sold by the MoD in 1999, and has since passed through a couple of ownerships. A visit will be arranged for Subbrit members in the future. The owner is keen to hear from anyone with historical information about the site, and can be contacted at bervietechsite@gmail.com

Recording twentieth-century wartime landscapes in Scotland

The defence works of Britain were widely regarded for a generation after the end of World War II as ugly lumps of concrete and reminders of unhappy years best forgotten. Rooms, underground or otherwise, and tunnels were all too often used as lavatories by passing visitors. Equivalent structures may very well have been seen in the same light by those living with them after there was an immediate practical purpose for, say, Hadrian's Wall or Porchester Castle.

Roman Richborough was probably hideous and terrifying to the natives of the day. But, as Historic England and English Heritage now recognise, all such structures of whatever age are immensely important elements of our nation's history, which should be publicly accessible and understood. Now, even many Cold War sites are officially recognised and protected as Listed Buildings or Scheduled Ancient Monuments.

From the 1970s onwards many people and organisations have located, identified the purposes of, and recorded thousands of twentieth-century wartime structures, including of course members of Subterranea Britannica and the Fortress Study Group. Progress with this sort of endeavour in Scotland is described in the recent issue of the Fortress Study Group's journal.

The Defence of Britain database recorded 1,975 wartime sites in Scotland, of which 733 were anti-invasion sites. These numbers have been increased to 2,886 and 1,975 respectively by more recent work reviewed by Geoffrey Stell. The geographical distribution of sites is impressive. Even the very remote island of St Kilda had a World War I gun position, which is illustrated (with the gun in place).

SOURCE: STELL, Geoffrey, 2015, Recording twentieth-century wartime landscapes in Scotland: a summary of progress. *Fort* 43

Man who feared a Cold War missile strike is selling his house complete with a nuclear bunker

Sub Brit member Mike Thomas built the underground bomb shelter 20ft below his kitchen in 1985 when tensions between Russia and the West were at their peak. The 300 sq ft cavern has concrete walls which are 32 inches thick and enough food and water to sustain his family for a month. It is one of the strongest privately-owned bomb shelters in Britain and can withstand a one megaton nuclear blast – much bigger than the 0.012 megaton 'Little Boy' dropped on Hiroshima.

Mike said: "I built the shelter because I was concerned about the threat of a nuclear attack. Who knows what will happen in the future? It wouldn't surprise me if there was a terrorist nuclear attack within the next 15 years. The room is incredibly strong and has everything you need inside. If the worst did happen it is exactly where you would want to be."

Mike, an electrical engineer, became obsessed with the nuclear threat when he served as a member of the Royal Observer Corps. So he decided to build the fall-out shelter to keep his family safe at their home in Lydenford, near Brixham in Devon. It took six months to complete with the help of a civilian engineer who built bunkers for the Ministry of Defence and cost £45,000 – or £200,000 at today's prices.

The huge blast door in the upper level room of the bunker. This room is accessed through a door in the back of a wardrobe. Photo Nick Catford

The shelter – which did not require planning permission because it is underground – has two entrances, a shaft from the kitchen or through a fake wardrobe in the study. Each is protected by huge steel blast doors and there is also an emergency exit buried under soil in the garden in case the main doors are welded shut by the blast.

The bunker, which has six bunk beds, has its own Swiss-made ventilation system and power supply with a diesel-powered generator and numerous batteries. Its concrete floors are covered with carpets and plywood sheets line the walls; the temperature inside remains a constant 12C.

The hideaway is lined with angle girders filled with hundreds of tons of concrete and steel reinforcing bars to create walls up to 32 inches thick. It features a 1,400-litre water tank, toilet, a small hand basin, and a phone line.

The bunker is also stocked with enough tinned and dried food to feed Mike, his partner Mandy and son Daniel for a month. Other mod cons include a TV and DVD player, a microwave and a range of board games and books to pass the time. He designed the shelter to ensure it would withstand an atomic bomb attack on the nearest potential military target, the Royal Naval College at Dartmouth less than two miles away.

Mike has now put his four-bedroom house and bunker on the market for £350,000.

SOURCE: SWNS.com

Military tunnels to find a new life as a wine cellar, Gibraltar

What are said to be 32 miles of tunnels driven into the Rock of Gibraltar from the 18th century onwards are proposed to be used, in part, as a cellar for at least £30m worth of fine wines, with work scheduled to start in October 2015.

The complex has been handed over to the Government of Gibraltar by the Ministry of Defence, and one Tracy Lee of Gibraltar Wine, with completion of Phase 1 of the conversion due to be completed in 2017. An interpretation centre is also intended.

SOURCE: KASSAM, Ashifa, 2015, Gibraltar plans world's biggest wine cellar. *The Guardian*, 12 October 2015

Last Vulcan bomber grounded

Vulcan bomber XH558 touched down for the last time on 28 October after its final season of air shows and fly-pasts was watched by hundreds of thousands of people. The former RAF aircraft ended service in 1993, but was restored by a charity trust of enthusiasts and took to the air again in 2007.

The advancing age of its airframe and engines meant experts decided that 2015 had to be its last flying year. However XH558, delivered to the RAF in July 1960, will be the centrepiece of a new museum exhibition about British engineering and the Cold War. It had a crew of five and was able to reach a maximum altitude of 55,000 feet at a maximum speed of 645mph. Its armament was one Blue Streak nuclear missile or one free-fall nuclear bomb or 21 conventional 1,000lb bombs.

The bomber ended service with the RAF in 1993. Its final duty flight was on 23 March 1993 to Bruntingthorpe Aerodrome in Leicestershire, having been sold off by the Ministry of Defence to C Walton Ltd, a family firm who purchased and maintained it, with the thought that one day, it might be returned to flight.

SOURCE: Daily *Telegraph*, 4 November 2015

Anxiety concerning American nuclear waste in the Marshall Islands, Pacific Ocean

The USA detonated sixty-seven nuclear weapons at Bikini and Enewetak Atolls in the Marshall Islands during a period of 12 years from 1946 to 1958. In 1948 the inhabitants of those places were relocated to another atoll 120 miles away with, it seems, little or no say in the matter.

XH558 is seen flying along the River Thames near Gravesend during a tour of Southern England on 11 October. Photo Nick Catford

Subsequently a 'cleaning up' operation saw 84,000 tonnes of radioactive debris containing amongst other radio-nuclides plutonium 239 (half-life 24,000 years) buried in an unlined 100m diameter crater under a dome or shell of concrete with a thickness of 0.45 metre, which might be thought somewhat flimsy protection for such dangerous stuff. Half the plutonium content will remain lethally radioactive around twelve centuries from now.

The so-called Rumit Dome, made in 1979, is now leaking. It is on low-lying land close to the coast, and now threatened by rising sea-levels resulting from climate change. The island is uninhabited, but much-visited by fishermen and by people scavenging scrap metal. There are no warning signs around the dome.

The Rumit Dome. Photo James P Blair

Sub Brit members have seen, on the Yorkshire coast for example, what marine erosion has done to reinforced mass concrete structures a great deal more substantial than half a metre thick in just 70 years since the end of World War II. Understandably, there is currently considerable anxiety about even, in radioactive decay terms, the very short term security of the stored debris.

The depository was intended only as an interim solution to the problem, pending the construction of a more durable and permanent store. The 1979 clean-up cost US$218m. The bill for a 21st-century replacement for the leaking store is clearly beyond the resources of the 53,000 Marshall Islanders whose representatives it seems in 1983 signed an agreement with the USA 'settling all claims, past, present and future' relating to the US nuclear testing programme. With hindsight, then, the present situation results from seriously flawed decisions all down the line.

SOURCE: JOSE, Coleen, 2015, Under the dome – as Pacific rises, what next for America's toxic nuclear legacy? *The Guardian*, 4 July 2015.

Iran releases unseen video of secret underground missile base

For the first time ever, Iranian television has broadcast footage of a secret underground tunnel stocked with missile and launcher units. Officials have said it is one of several such bases in the Islamic republic.

Located at a depth of 500 metres under the mountains, the footage shows a very long tunnel which appears to be about 10 metres high. It is one of many missile bases in Iran, according to Brigadier General Amir Ali Hajizadeh, commander of the Islamic Republic's Revolutionary Guards' aerospace division.

"The Islamic republic's long-range missile bases are stationed and ready under the high mountains in all the country's provinces and cities. This is a sample of our massive missile bases," he said, adding that "a new and advanced generation of long-range liquid and solid fuel missiles" will replace the current weapons in 2016.

He issued a warning to anyone who might threaten Iran by suggesting that they had better "have a look at the Islamic Republic's army options under the table."

SOURCE: *Russia Today* (website)

Plymouth's Mount Wise bunker may be demolished

The nuclear-blastproof bunker at Mount Wise is unlikely to become a data centre as planned – and may even have to be demolished.

Developer Mount Wise (Devon) Ltd, which owns the entire 28-hectare site, has looked at various possible uses for the labyrinthine, subterranean bunker. It had been mooted as ideal for a £20million data storage centre, with the rooms being filled with servers, keeping them secure and cool. But the necessary initial investment of £10million, and the high cost of running a building which needs to have power, water and even air pumped in, have proved a hurdle.

Other talks – on uses as diverse and bizarre as a paint-balling centre, storage of documents, wine and high-end cars, or even for growing mushrooms – have proved fruitless, again because of the high cost of refurbishing and maintaining such an unusual building.

That leaves the developer considering its future, and whether the structure should even be removed, though it stressed no decision has been made.

The two-level command centre in 1958

The bunker was constructed at the start of World War II as a command centre with two levels of rooms including a Battle of Britain-style war room – and all under seven and a half feet of reinforced concrete.

The centre was used by the MoD throughout the Cold War until 2004, and housed up to 200 staff. But when the Mount Wise Royal Navy site was sold off for housing in 2006 the bunker provided a headache for the new owner Mount Wise (Devon) Ltd.

The bunker has been visited by members of Subterranea Britannica on a number of occasions, most recently in December 2009 when 43 members travelled down to Plymouth from all over the country for a midweek visit.

SOURCE: *Plymouth Herald*, 5 August 2015

NEWS – MINES & MINING

Even more chalk mine subsidences in and around Reading and south Oxfordshire

The very wet winter of 2013/2014 brought to light numbers of abandoned chalk mine sites in southeastern England. White 'Upper Chalk' is a highly porous rock which, by volume, is 40% or more empty and usually air-filled voids. But after saturation with prolonged heavy rainfall it of course contains around 40% water filling the voids, thereby increasing significantly in density. An excess of water also fills cracks and joints in the rock.

Masses of chalk in chalk mine ceilings are thus much heavier than usual, and the cracks and joints between them are lubricated, resulting in roof-falls. As most chalk mines are at relatively shallow depth, these roof-falls migrate upwards to break surface as 'crown holes' or craters, which in the said winter have been appearing in lawns and driveways, and even under houses, newly built in chalk districts.

Thus we are reminded that the coalfields and the metalliferous mining regions such as Cornwall do not have a monopoly of abandoned mines. Chalk mines have been tunnelled under, for example, Berkshire, Buckinghamshire, Essex, Greater London, Hertfordshire and Kent. Recent press reports have concerned subsidences at Upper Basildon (near Reading), and Nettlebed (south Oxfordshire).

Chalk mines were commonly excavated below brickfields, the brickmaking clay dug from open pits being mixed with chalk from mines below them before being moulded and fired. Although after the 1872 *Metalliferous Mines Regulation Act*, such mines were subject to government regulation and inspection, surviving records are lacking in detail concerning their exact locations and extent. The requirement of the Act that on abandoning a mine a plan should be filed at the then Mining Records Office applied, unfortunately, only to concerns employing at least twelve men underground. As most chalk mines, certainly in their final years before closure, had very small workforces, very few abandonment plans were made and deposited. First and second edition Ordnance Survey large-scale plans show late 19th-century brickfields, and some actually indicate mineshafts. However, conventions adopted by the surveyors led to shaft tops not open to the air not being marked on the plans. As such shafts were usually under sheds or at least some sort of roofing to keep rain out, so could not be seen from a 'bird's eye view', they were often not mapped. If you contemplate buying a house on chalk lands in any of the counties mentioned above (and others such as Norfolk and Suffolk) bear in mind the 'chalk mine problem' and at least look at the early OS large-scale plans to see if your possible new home is on an old brickfield site! If it is, further research into the site history is advised!

Readers will have noticed that Surrey and East and West Sussex have not been mentioned, although all three counties of course have extensive chalk downland within their borders. It is a curious and as yet unexplained fact that little or no chalk mining has been recorded in these areas. Surrey and Sussex have been credited with some actual or suspected denehole (medieval chalk mine) shafts, but they seem to have been far less common than in Essex and Kent. There are underground chalk quarries (for building-stone) at Mickleham and Guildford (Surrey), but no extensive pillar-and-stall chalk mines are (yet) known in the county. Why this should be is a puzzle!

SOURCES: HUGHES, Peter, 2014, Old mine workings thought to have caused sink hole. *Oxford Times*, 27 February 2014; [Nettlebed (South Oxfordshire): 4m wide sinkhole opened on 7 / 8 February 2014 / there had been an earlier one nearby in 1990 / thought to have been caused by chalk mines]; MILLWARD, David, 2014, Mines: hole appeared in driveway: car damaged by 8 ft crater. *Get Reading*, 14 February 2014 [Upper Basildon: 8 ft wide x 8 ft deep at the location of the former Basildon Brickyard and Kiln worked c. 1850s–1900 / thought to be subsidence into abandoned chalk mines]

New Blue John vein discovered at Castleton, Derbyshire

'Blue John' is a rare purple variety of the otherwise common mineral fluorite (calcium fluoride); it has been mined at Castleton for ornamental purposes for several hundred years, although the mine is currently predominantly a tourist attraction rather than an industrial enterprise.

A newly discovered vein of the prized mineral has been reported from Treak Cliff Cavern, '150 years after the last discovery'. See:
www.bbc.co.uk/news/uk-england-derbyshire-33984791

SOURCE: ANON, 2015, New Blue John vein discovered. *Newsl. National Association of Mining History Organisations* 73 (September 2015).

Devon Tungsten Mine reopens

An adandoned tungsten mine known as Drakelands Mine, near the south Devon village of Hemerdon, became the first new mine to open since 1969. Tungsten was discovered on the site in 1867, but until this year no

extraction had taken place there since 1944, apart from an abortive pilot scheme that ran in the 1980s.

An Australian company, Wolf Minerals, has invested around £140m in the site since obtaining a 40-year lease in 2007. It hopes to extract 3,500–5,000 tonnes of tungsten every year, which would make Drakelands one of the world's five biggest producers of the metal; the open-cast mine will also yield around 350 tonnes of tin a year. The site is believed to contain enough metal for twenty years of mining.

The price of tungsten, which is most commonly used in industrial machinery, doubled at the beginning of the decade but has tumbled back again in the past three years. Wolf Minerals sells its Devon tungsten in concentrate form for £9,600 per tonne; it expects its average cost will be about £8,300 per tonne once the mine has been running

The opencast mine

for a few years. Russell Clark, the firm's managing director, believes that tungsten prices will rebound, in part because mines in China and America are running low. If that does happen, "we'll be in the absolute box seat," he says.

The authorities in Devon, where wages are 13% below the national average, are glad to see the opening of the mine, which employs 200 people. Originally it had permission to operate for only five-and-a-half days a week, but the county council has recently agreed to let the pit run every day as part of a six-month trial. See previous news item in *Subterranea* 39.

SOURCE: *The Economist,* 31 October 2015

The legacy of coal-mining in South Wales

Fifty kilometres of the Heads of the Valleys road in South Wales, from Hirwaun to Abergavenny, is being widened. The land is riddled with abandoned colliery shafts and tunnels, the exact locations of which are imperfectly known. Locating and grouting all voids under the road would be prohibitively expensive, so an alternative solution is being adopted.

While some cavities under the widened road alignment detected by drilling will be backfilled, a 'geogrid' is being created below the carriageway. This, it is intended, will be strong enough to support the road, and monitoring will detect any crown-hole collapses threatening to break surface before a major collapse develops. Targeted remediation of detected failures would then follow.

Mining-induced ground instability is the subject of a letter recently published in the magazine of the Geological Society. This suggests that in the 3000 square kilometres of the South Wales Coalfield there have been over 620 coal mines worked during a century of mining in up to eight coal seams at depths between 75 and 300 metres below the valley floors. This area, as a consequence, has the highest concentration of landslides in western Europe.

Mine mechanisation in the 1930s, and especially the introduction of longwall mining, which achieves 100 % extraction of a seam, the land above being allowed to settle onto waste rock left underground. Settlement of this kind in up to eight seams one above another inevitably affects the surface, and mining-induced minor earthquakes (or ground tremors) can trigger ground movement and spoil-tip collapses (as happened famously at Aberfan) with unpredictable but generally unwelcome results.

SOURCES: BENTLEY, Stephen P., 2015, Study the ground beneath your feet. *Geoscientist* 25(9); SMALE, Katherine, 2015, Roads: Heads of the Valleys Improvement: across the mines. *New Civil Engineer,* 10 September 2015

Proposed second potash mine, North York Moors National Park

Sirius Minerals proposes to sink a mine for potash in the North York Moors National Park, with kilometre-deep shafts inland from tourist attraction Robin Hood's Bay. The material intended to be mined is the mineral polyhalite (a hydrated sulphate of calcium, magnesium and potassium), a bed of which up to 70 metres thick has been proved at the cost of £125m worth of boreholes and associated work. The total reserve is estimated to be 2.7 bn tonnes.

Polyhalite has a significantly lower proportion by weight of potassium than carnallite (hydrated magnesium potassium chloride) which is mined at the similarly deep Boulby mine near Saltburn further up the East Yorkshire coast , where mines which run in part under the bed of the North Sea have been developed in the last forty to fifty years.

Points for and against the National Park Authority granting planning permission are economic and environmental. On the one hand, the area is one of very high unemployment rates, especially in nearby towns such as Middlesbrough and Stockton, and a second potash mine both during construction and when operating would alleviate this; the Boulby mine has for forty years or so been a major employer locally, with more employed than at any other mine in the UK.

Potash is a major British export, competing with producers in Canada, Germany and Russia, and there is a need for agricultural fertiliser (the main use for the polyhalite) to improve food production for an increasing world population. On the other hand, five years of construction work are thought likely to impact

significantly on income from tourists visiting the national park and the scenic coast.

Once constructed and operating, the mine is expected to be almost invisible, with mine buildings in a 'blind spot' in the landscape. Material is to be transferred via a 36-mile-long tunnel to an export berth at Wilton on Teesside, near a surface processing building. There would be three intermediate shafts up to 245 metres deep for emergency access, maintenance and ventilation, the construction and operation of which would be within the national park's landscape. Material from the long-established mine at Boulby is sent to docks at Teesside by rail, using a pre-existing line (closed to passengers south of Saltburn) northwards along the coast and via Redcar.

SOURCE: CRITCHLOW, Andrew, 2015, Yorkshire Moors mining plan gets that sinking feeling. Sirius Minerals hope to dig 2.76 bn tonnes of potash from beneath a national park – but planning report could put an end to project. *Sunday Telegraph,* 21 June 2015

Tin-working landscape conference in Devon in 2016

The first international conference exploring the tin-working landscape of Dartmoor in a European context is to be held in Tavistock from 6–11 May 2016. It marks 25 years of the Dartmoor Tinworking Research Group, and ten years of the UNESCO World Heritage designation of the Cornwall & West Devon Mining Landscape.

Twelve lectures (with speakers from Czech Republic, France, Germany and Iberia, as well as Britain), four evening events and three full days of field trips, will make this a truly memorable and important occasion for anyone interested in Dartmoor's history and archaeology. Delegates will receive a conference booklet and a special medallion crafted in tin.

All bookings must be received by 30 April 2016. The full Conference Programme and details about booking are now available on the DTRG website: www.dtrg.org.uk

SOURCE: DTRG press release, 30 October 2015

NEWS – MISCELLANEOUS

Pavement collapse in North End Road, Fulham, west London

On 23 April 2015 a woman and her shopping trolley rather suddenly disappeared into a four metres deep hole in North End Road, Fulham. It was reported that she had ignored hazard warnings which had been put in place to indicate a weak and subsiding section of pavement outside a café. The pavement collapsed under her. The cavity, from which she was rescued, apparently not seriously injured, via the café's basement and stairs, appears to have been a disused under-street coal cellar.

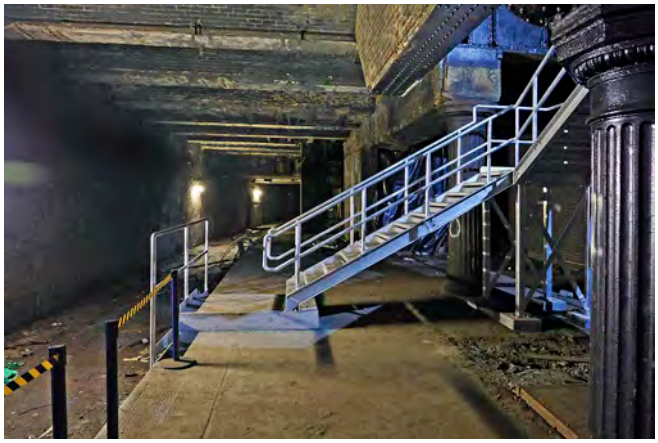
SOURCES: *The Guardian,* 24 April 2015; *Metro,* 24 April 2015

Network Rail starts tours above and below Glasgow Central station

Glasgow Central low-level station closed in 1964 although in 1979 part of the station reopened for the new Argyle line reusing some of the old station site; however a large portion of the station including an island platform was not reused.

Tours of Scotland's busiest railway station have now been launched. Visitors climb ninety steps and walk across catwalks above the station concourse to access the giant roof area. At its highest point, the roof stands 40ft above the concourse. It was completely renewed in 1998 as part of an £80m station renovation. Once on the roof, visitors will be able to enjoy panoramic views across the River Clyde and city skyline.

From there, tourists will descend winding stairwells to see what remains of the Victorian storage vaults of Grahamston village, which once bustled with shops and activity before the station was built over the top of it in 1879.



The new access steps to allow visitors to view the low-level suburban platforms. Photo Dave Campbell

Visitors will also be able to visit the abandoned railway platforms below Glasgow Central station built as part of the suburban railway line that ran from the west end of the city to the east end and incorporated the famous Glasgow Botanical Gardens station. There is a special viewing point set up on the tour to allow visitors to see the platform.

Tickets cost £13 and can be booked online at www.glasgowcentraltours.co.uk/tour-feature/the-victorian-platform

SOURCE: Glasgow Central Tours website

Somewhere in the UK not yet visited by Subterranea Britannica

Subterranea Britannica members, collectively and individually, have gone underground at an astonishing number and variety of underground places in the last forty years. But, so far, the pumped storage hydro-electric power station at Ben Cruachan in Argyll and Bute seems to have escaped our attention. An article recently published in the arts pages of *The Guardian G2* provides some details.

The location is remote, described as a two-and-a-half-hour train journey from Glasgow, followed by a kilometre-long drive down a tunnel into a mountain. As with the better-known 'Electric Mountain' in Snowdonia, there are public guided tours to the turbine / generating

hall, blasted out as a huge cavern in ancient crystalline rock. An unexpected extra is, it is said, the remotest public mural art work in the UK.

This 48 feet by 12 feet mural combines ancient Scottish and modern industrial themes, including Celtic crosses and high-voltage power line pylons. It was constructed, panel by panel, by Elizabeth Falconer, now 87 and living in Chiswick, west London, and assembled underground in time for the station's official opening by the Queen on 15 October 1965. The artist has never seen the work assembled and complete, although her son has made the trip, and pointed out that her name had been misspelled (Faulkner) in the display.

The turbine hall housing the four Francis turbines, which operate as both pumps and generators, is 300 ft long, 77 ft wide and 125 ft high

Three thousand construction workers created this subterranean power house, of which thirty six died during the work. As at the comparable North Wales station, the Ben Cruachan stations uses cheap off-peak electricity to pump water to an upper reservoir on the mountain. This is released through the turbines to generate current to meet peak demand in Glasgow and around.

The process makes economic sense as conventional fossil fuel power stations are expensive to fire up and shut down, each process taking some hours. It is cheaper to keep the conventional stations running continuously and use the off-peak current to store the output as potential energy by pumping water up to a higher level. Fluctuating and peak demands can be responded to almost instantaneously by increasing or decreasing the stored water flowing by gravity through the turbines.

SOURCE: OLTERMANN, Philip, 2015, There's old in them there hills. *The Guardian G2*, 13 October 2015

Crystal Palace underground 'public convenience' is converted into a des res

The British architect Laura Clark made a grand renovation on a property by transforming an abandoned public toilet into an incredible private home. The 600m² site is located underneath Crystal Palace Parade in south London. What used to be a simple bathroom has now become a practical London home with living room, bedroom, kitchen, and small patio.

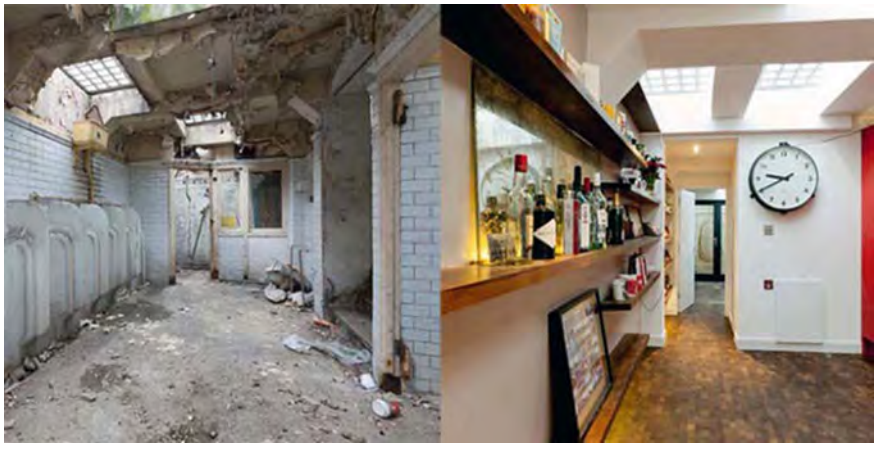
Clark became aware of the public toilet in 2005. Young, and recently graduated from Glasgow School of Art, the architect had just moved to London when she decided to take up the project. "For me that's about saving sites with an interesting history, but which have been abandoned and forgotten."

The toilets were built in the late 1920s and served their main purpose until the 1980s. Clark decided to transform the site into a one-bedroom apartment since the property was not available for commercial use. After countless meetings with Lambeth Council's regeneration department, the architect finally bought the place in 2011.

The property then evolved from old toilets to a bright and comfortable home. The end result of all the years of hard work put in by Clark is a cosy and light-filled one-bedroom apartment she now calls home. The kitchen tiles and a mirror in the living room were restored from the original structure as a reminder of the building's origins. The luxurious bathroom counts with a gold-leaf wall which she added herself to add a touch of glamour to it. The apartment even comes with a cute subterranean garden that gives it a fresh and homely feel.

Clark even left a small public health poster warning of the perils of VD in the kitchen to lighten up the mood. The entire project for this luxurious little apartment cost Clark a total of £65,000 and a whole lot of creativity and energy.

SOURCE: Interestingengineering.com, 5 October 2015



Before and after

Radioactive waste disposal

Radioactive isotopes are known for all naturally occurring elements, and of course for all elements entirely created by man. Some are inescapable. There would be no life on earth without, say, carbon and potassium. Carbon 14 (so useful to archaeologists for dating ice age to recent organic material) has a half-life of 5570 years, which means a quantity of this isotope has decayed in that time, and half again in the next 5570 years, and so forth. Potassium 40 (0.012 % of all naturally

occurring potassium) has a very long half-life of 1.2 x 10,000,000,000 years! Without potassium salts in your bloodstream, your nervous system wouldn't work. Every living thing on earth has from the beginning of life itself been mildly radioactive: we just live with it.

But nuclear fission, whether in reactors or atomic bombs, results in vast numbers of additional radio-isotopes hitherto unknown to our planet. Some have half-lives of a fraction of a second, others of millions of years. Partly these radio-isotopes are fission products representing bits of the plutonium or uranium atoms that had been 'split'. But the intense neutron flux inside a fission device has the unfortunate effect of converting almost every other otherwise normal atom into a radioactive version. And, crucially, there is nothing you can do to render highly radioactive material safe other than keep it safe for a great many years longer than human beings have evolved on this planet.

Safe from mountain-building (the Alps and Himalayas and Andes were sedimentary rocks pushed up from the sea bed millions of years ago). Erosion (some of the rocks in western Scotland now at the surface were formed at immense depths in the earth's crust, at pressures forcing carbon to convert to diamond). Shorter-term hazards include groundwater dissolving away soluble rocks (gypsum, limestone rocksalt &c) and earthquakes and major faults such as the famed San Andreas in the USA.

By far the best solution to radioactive waste disposal would be to launch it into space, destined to crash land on the sun: but space rockets have been known to explode on their launch pads, or fall back to earth. So all bets are on deep-level storage in places which geologists calculate will stay secure for thousands of millions of years, on what is a very geologically mobile planet.

A review of the deep storage options notes experimental deep-waste depositories currently constructed at various places in Finland and Switzerland. These are being monitored, and not yet actually in use. The article cited includes some underground photographs.

In the UK nuclear fission and power generation has been with us now for 70 years, and all the dangerous waste is still stored at surface in tanks which may or may not withstand the odd earthquake, aeroplane crash, or terrorist attack. Choosing the most reliable rock conditions for a deep-level store up to a kilometre below ground means understanding the geology at that depth in great detail. What sort of rock is it? How fractured is it? Is it in a part of the UK more than ordinarily prone to earthquakes (remember that even London had two earthquakes in a single year in the 18th century!).

SOURCE: ALA, Natalyn, 2015, Solid foundation: .. public consultation about radioactive waste disposal, *Geoscientist* 25(9)

Police training centre to be built in disused reservoir near Bedford

British police officers, security guards and soldiers will be trained to combat domestic terrorist attacks in an underground bunker simulating everything from hostage rescues to raids on airports, hotels and schools.

The National Firearms and Tactical Training Centre, to be built on the site of an underground reservoir for £20 million, will feature mocked-up houses that trainees will storm, halls that can be transformed into public spaces using computer-generated imagery, a taser-training area and five live-firing ranges.

The complex, on the outskirts of Bedford, will have six-feet-thick walls to ensure safety and sound proofing. Rooms furnished with couches and cupboards will recreate real-world search-and-rescue scenarios, while the largest 100-metre range is big enough to teach vehicle interception techniques. The privately funded centre should open in 2017.

The UK has been on a 'severe' threat alert since August last year, according to the MI5 intelligence agency, with security specialists suggesting the recent influx of Mideast refugees may be used as cover by terror groups, further increasing the likelihood of an attack.

Pillars will be removed and the ceiling raised by 1.5m.
Photo Paul Hackett

A £20m underground training centre to practise hostage rescues is set to open in 2017, with its private-sector backers banking on a rising number of armed police to

One of the multi-coloured lava tubes on Jeju Island

counter a growing terrorist threat.

The backers say they are in advanced talks with police forces to exploit the demand for cheaper firearms training that it says it can provide for £100 a day. Senior officers say that firing ranges are expensive to build and maintain and are looking to collaborate with the private sector to cut costs.

SOURCE: *Bloomberg Business,* 13 September 2015

An underground tourist attraction in South Korea

An article in the Travel Section of the *Guardian* of 29 August 2015 (page 14) notes in passing, with an underground photograph, 'the magnificent Geomunoreum lava tube system of underground caves'. The photograph shows a roomy high-ceilinged tunnel with a flat floor and uneven rock walls and roof, with lamps at floor level on each side, and several people walking through.

They are on the Jeju Island, 100kms off the country's south coast. A more rough and ready and capacious version of Kensington's Exhibition Road subway comes to mind. Your scribe (PWS) has visited much smaller lava tubes in Iceland, where they are explained in terms of molten lava draining out of flows which have solidified on the surface. There are some well-known examples on Tenerife and elsewhere.

A man has started building an underground bunker ahead of the apocalypse...in his back garden!

Inventor Colin Furze has teamed up with *Sky 1* ahead of the new comedy/drama 'You, Me & The Apocalypse', and is turning his back garden into a massive underground bunker. Colin's bunker will take almost two months to build in the back garden of his semi-detached house in Stamford and he is documenting the whole thing in six episodes on *YouTube*.

The ceiling is nearing completion

Episode 1: The plan
(www.youtube.com/watch?v=8UKNajCgpEs)

Episode 2: The dig
(www.youtube.com/watch?v=z8yiuJ9yFic)

Episode 3: Making the bunker. Colin lays the steel floor, walls and ceiling to the bunker, so it finally takes shape
(www.youtube.com/watch?v=p1t7r3SKT2o)

Episode 4: Lifestyle expert Patricia Bright joins Colin to help with the interior design
(www.youtube.com/watch?v=pR493Pee6Xo)

Episode 5 will see the completion of the bunker.

Episode 6 mirrors the narrative of the *Sky 1* drama with YouTubers meeting in the bunker to watch the end of the world (well, the season finale!). The final video will take advantage of *YouTube*'s 360 video function to give a full tour of the bunker. Colin also has a role in the *Sky 1* drama. He appears as a market trader selling blueprints for an apocalyptic bunker, blurring the lines between drama and reality.

SOURCE: *Rutland and Stamford Mercury,* 28 September 2015

Vaults beneath Peterborough Museum opened to the public

Few places can boast such a rich and varied history as Peterborough Museum, and for the first time colourful characters from the museum's past are set to be brought to life as the 500-year-old museum starts regular tours for the first time into its underground vaults. Visitors will be greeted by characters who used to work there centuries ago. Laser imaging will project images of real people from the past onto the cellar walls who will then inspire the tours with their life experiences.

The characters are played by actors from Peterborough's Lamphouse Theatre Company and range from a mysterious medieval monk to a young girl experiencing a bombing raid in the Second World War which destroyed nearby buildings in Priestgate.

In the past five centuries the museum has been a Tudor mansion, a Georgian magistrate's home, a Victorian hospital and an air-raid shelter, which tour-goers will learn more about in the cellars.

The tour is led by a costumed guide, who shows visitors around the building by candlelight, explaining the various paranormal happenings at the sites where they have taken place, including the back stairs, where people have reported a ghostly servant falling to her death. A phantom girl has been seen and heard in recent months, and you will also hear the story of the Museum's most notorious ghost, the 'Lonely ANZAC' Thomas Hunter.

Tickets for the tour are £5 for adults, £3 for concessions. Due to limited places, tickets are strictly pre-booked only. Tours last about 90 minutes. To book on a tour, call the museum on 01733 864663.

SOURCE: *Peterborough Telegraph,* 22 October 2015

NEWS – PUBLICATIONS

Industrial archaeology in Sussex

DETAILS: BLACKWELL, John, Peter HOLTHAM, and Martin SNOW, 2015, *A guide to the industrial archaeology of Sussex*, Association for Industrial Archaeology: 76pp [ISBN 978-0-9560251-4-2]

The Association for Industrial Archaeology held its 2015 annual meeting at the University of Sussex, with local arrangements made largely by the Sussex Industrial Archaeology Society. As usual, a guide was published, this year's booklet dealing with the two counties, East Sussex and West Sussex.

Along with some general introductory text, the contents consist mostly of brief descriptions of, mostly, standing buildings and structures. Defensive, military and Cold War sites are hardly noticed, and no more than four more or less underground features are included, these being an ice-house at Bognor, the castellated north portal of the Clayton rail tunnel, the West Hill Cliff Lift (partly in tunnel) at Hastings, and the 1936 'Beehive' terminal at Gatwick Airport (the subway connection with the first railway station is mentioned).

As Subterranea Britannica members will know, especially those who attended the Study Weekend based at Eastbourne, there are numerous underground sites in the county, including the only working mine (for gypsum) still operating in southeast England.

The Fauld Disaster – 27 November 1944

Book review by Martin Prosser

DETAILS: McCAMLEY, Nick

Published by Folly Books Ltd, 30 May 2015.

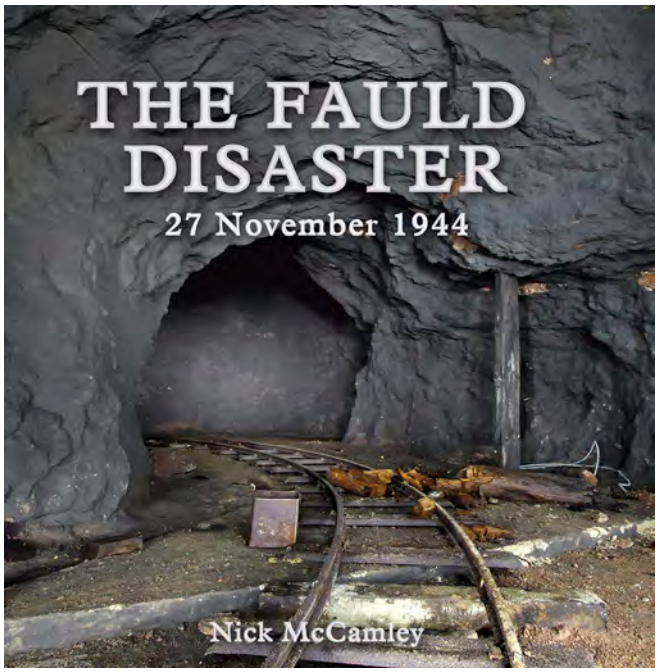
250 pages 260 x 250mm, hardback with dust jacket. ISBN: 9780992855437

Illustrated with 296 black & white archive and contemporary colour photographs and numerous maps and plans.

This is another richly illustrated, large-format book produced in a similar style to the publisher's previous titles, and with the similarly high production values that we have come to expect from the Folly Books stable. The book is the definitive history of the RAF's ill-fated excursion into underground bomb storage during the Second World War, culminating in the disaster at Fauld, Staffordshire, in November 1944 in which 4,000 tons of bombs stored in the RAF's largest underground ammunition depot exploded, destroying much of the depot, devastating the local landscape and claiming seventy lives.

The first 103 pages are dedicated to a detailed analysis of RAF bomb storage policy in the interwar years, with illustrated descriptions of all the underground and surface depots built at that time, including the ill-fated underground store at Llanberis which collapsed shortly after being brought into use in 1942.

The rest of the book details the construction and operation of the Fauld depot, culminating in a minute-by-minute account of the moments leading up to the disaster and its aftermath. The photographs illustrating this section of the book are breathtaking – both the B&W images



taken underground in the hours and days that followed the explosion, and the stunning colour images of the surviving features as they are today.

Sealed since the 1960s, the remains of the depot were briefly accessible a few years ago and the opportunity was taken then to make a photographic record of what remains. Many of these photographs can be seen for the first time in the book, including some awe-inspiring images of the scorched and smoke-blackened passageways beneath the rim of the crater.

As the author said in a private communication, 'It was a cathartic experience to stand in the doorway of the office through which Storeman Salt, as he describes in his evidence to the subsequent Court of Inquiry, was thrown by the force of the blast.'

I can probably not do better, to finish this review, than poach from another review, found on the Amazon website, by Kenneth Morris, who says:

'As a resident of a property just over a mile from the Fauld crater, I have read at least four previous works relating to the explosion in 1944. None have got anyway near the forensic analysis achieved by Nick McCamley. This superb book not only goes into great detail about what happened but also charts exactly why the place was (almost accidentally) chosen. With scores of detailed plans, photographs and documentary exhibits the whole is a triumph of reportage. Very thoroughly recommended.'

The Royal Observer Corps in Lincolnshire & Humberside by Chas Parker

Review by Terry Hancock from the Society for Lincolnshire History & Archaeology

In 1991 Chas wrote and published a booklet about the

history of the ROC in Lincolnshire and, like many other authors before him, found that this resulted in him receiving much more information from ex-members, plus from his own subsequent research. The result is this much enlarged version (112 pages), which also covers Humberside as originally the posts in north Lincolnshire came under York Group. Chas starts by looking at the origins of the Corps, special constables enrolled to report seeing Zeppelins as part of the home defence system set up as a result of the public outcry over such raids; this organisation quickly disappeared after WW1 but had proved its worth and in 1925 the Observer Corps was formed, initially just in South-East England, facing the only country militarily strong enough to be a potential threat at the time – France. When the real enemy, Germany, became apparent the Corps expanded north and west. Chas covers WWII, when even with the advent of radar, the Corps had an essential role of inland spotting – and helping friendly aircraft which were lost. Disbandment came again at the war's end but only until 1947 when the 'Cold War' saw the RAF reform the ROC as a vital part of the air defence system – but as aircraft flew higher and faster, the Corps faced disbandment again in the 1950s; it was saved by a new role, that of reporting nuclear bursts and the subsequent nuclear fallout and, for this, the observers moved underground. During 1968 the strength of the Corps was halved by the Wilson government but with the end of the Cold War the Thatcher/Major governments saw no further use for it and the ROC was summarily stood down in 1991, in a disgraceful manner that I, as a then observer still remember, particularly the way it was communicated to the full-time staff.

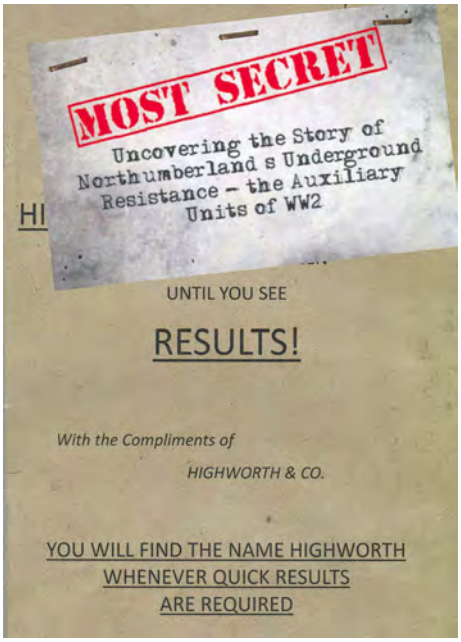
A rump of the Corps carried on until 1995 in armed forces HQs but then came to an end a unique organization. Chas covers all this, with photos, maps, a gazetteer of all the posts and ops rooms, plus much more in a well-written and interesting book (even for those who weren't members).

The Royal Observer Corps in Lincolnshire & Humberside is published by the Lincolnshire Aviation Society ISBN 978 0 9518365 1 4. Available at £13.95 post free. Contact c.parker8@ntlworld.com for more details.

Most Secret – Uncovering the Story of Northumberland's Underground Resistance – the Auxiliary Units of WW2

The history of the Second World War is full of extraordinary stories of courage, ingenuity and sacrifice. It was a period of 'total war', when the men and women of Britain were called on to carry out the most incredible tasks, but one of the most astonishing was that of the Auxiliary Units.

They were a group of men and women who volunteered, in the event of a successful enemy landing, to stay behind enemy lines and carry out sabotage and espionage in order to help push the invaders back into the sea.



Kept secret for so many years, it is only in recent years that their story has emerged.

Most Secret – Uncovering the Story of Northumberland's Underground Resistance – the Auxiliary Units of WW2, reveals details about what happened in Northumberland.

It is thanks to the efforts of four men: Stephen Lewins, from Morpeth; Bill Ricalton, who drew on his experience as a youngster during the war in Longhorsley; Phil Rowett, from Berwick; and Sub Brit member Ian Hall, from Alnwick, whose Wanney Books has published this new addition to the ever increasing catalogue of books about the Auxiliary Units.

In the introduction, they write: 'We hope that, in a small way, we can give some recognition to the brave men and women of Northumberland who volunteered for what was, potentially, the most hazardous work. Though they were never called upon in their role as Auxiliaries, they volunteered with open eyes, knowing that in the event of invasion, their life expectancy would probably be measured in days.

The 40-page book tells the story of Auxiliary Units and their underground operational bases (OBs) and the Special Duties section, the espionage units set up to collect intelligence from behind enemy lines. The book lists 21 sites in Northumberland and is well illustrated with photographs and diagrams of many of the surviving features. It is very modestly priced at £5.50 (post free) and is available from Wanney Books at 15 Fairfields, Alnwick, NE66 1BT. It can also be purchased using PayPal through their website. www.wildsofwanney.co.uk/books.html

NEWS – TUNNELS & TUNNELING

Crossrail – London Underground connection made at Bond Street, London

The new Crossrail station tunnels at Bond Street have now been linked, but not yet of course for public access, to London Underground's Bond Street station. The

LU station is being enlarged by 30% with a new ticket hall under Marylebone Lane due to be opened in 2017. Crossrail trains are scheduled to serve the joint station a year later.

SOURCE: ANON, 2015, Breakthrough for Crossrail at Bond Street. *Evening Standard,* 1 October 2015.

Crossrail's connections with Winsford, Cheshire

Well before Crossrail tunnelling under London commenced in 2009 there was a programme of intensive site investigations, from 1992 onwards, to find out about the geology of the ground to be bored through. Alongside geophysical investigations data, a great many boreholes were drilled to depths of 70 metres or more, from which core samples were taken, these comprising cores of Chalk, Thanet Sand, Lambeth Group (Woolwich & Reading Beds sands and clays) and London Clay.

In the first instance, the information on rock bed thickness and composition informed the planning of tunnels to be driven without endangering buildings above. The harvested data will also be invaluable in connection with future tunnelling under London, such as Crossrail 2. And, as central London is not noted for geological exposures, such as open-to-the-sky clay pits and sand pits, the samples are of great geological value in providing far more data on the rocks and the fossils they contain than the Victorian geologists who commenced the study of the geology of London: to a large extent they had to rely on any records that may have been made by persons sinking wells.

Preserving all these rock samples is problematic, as they are liable to dry out and deteriorate. An above-ground environmentally controlled storage facility would be expensive to construct and operate, with the need for energy to operate humidity and temperature control equipment. The answer has been provided by the deep storage facilities at the rocksalt mine at Winsford, Cheshire, which some Subterranea Britannica members have been fortunate to visit from time to time.

This offers a constant temperature (15° C) and humidity. The impressive lengths of very generously proportioned worked-out mine tunnels under Winsford are also used for secure storage of many other items, including less often used books in the British Library's collections, historical archives, financial, hospital, police and university records, architectural models and so forth. There are 30 kilometres of tunnels available at a depth of around 150 metres, with a total floor area of 1.8 million square metres.

SOURCE: HARVEY, Dan, 2015, Preserved in salt. *Modern Railways* 72 (805).

Where does all the excavated tunnel spoil go from Crossrail, London

If you dig a tunnel or a mine or any other sort of excavation, you have to find a use for, or a place to dump, an amount of spoil more or less equal in volume to the space you have created. In the centre of London, there is nowhere to put it. And umpteen lorry loads through already congested streets are not welcome!

The three million tonnes of spoil from 42 kilometres of Crossrail tunnels, excavated by eight tunnel-boring machines, has largely gone to Wallasea Island, near Southend, Essex. In a joint project with the Royal Society for the Protection of Birds, Crossrail has created a 172-hectare nature reserve for birdlife. Landscaping the spoil to raise the ground level has provided for the creation of bird-friendly habitats such as creeks, pools, and salt marshes.

The land chosen was lower than the Thames, and had been 'reclaimed' from the river in the 1950s by excavating on site and building a perimeter sea wall. The now-raised nature reserve area is now at reduced risk of flooding by tidal surges and increasing sea levels. A similar strategy was adopted to dispose of chalk spoil from the British end of the Channel Tunnel. A new nature reserve called Samphire Hoe was created at the foot of the cliffs between Dover and Folkestone.

SOURCE: CRONIN, Ben, 2015, Wallasea Island landscaping: Island life. *New Civil Engineer,* 13 August 2015.

Tunnel of death in Tajikistan

The Anzob Tunnel was supposed to make life easier for people wanting to travel between Tajikistan's major cities. Before the tunnel was built, drivers had to cross the border into Uzbekistan via a dirt road in order to travel between the Tajik capital of Dushanbe, and its second biggest city of Khujand. They also faced the threat of year-round avalanches blocking the roads, leaving people with the only option of flying – simply too expensive for most.

So a 5km long, $4 billion tunnel, built by Iran, was meant to relieve the problem. The tunnel was officially opened in 2006 but remained unfinished until March this year. Within a matter of three months, it had to be closed for repair work, and reopened in September.

It quickly became known as the 'tunnel of death' by locals and those who braved the nightmarish journey.

Inside the Abzob tunnel. The tunnel was open to all traffic on this day. Photo Robert Thomson

It's a dark, dangerous place, with hardly any lights inside and it's suffocating as there's no ventilation bar one fan. Locals have shared stories of a number of people dying inside it due to traffic jams that leave people trapped, where they succumbed to carbon monoxide.

There's also the fact it's almost like an obstacle course, with huge, axle-snapping potholes threatening to swallow up the car, along with flooding that almost turns them into tunnel ponds. Throw in the hazard of falling rocks and you'll want to be alert if you take on the journey.

It's also quite narrow – with a two-lane system, often ignored as drivers dodge obstacles. Even in good weather conditions the tunnel is flooded, turning the giant potholes in the unfinished road into invisible death traps. Unmarked drainage channels waiting to swamp your bike. The tunnel lacks proper lighting and ventilation; breathing is hard and painful due to the thick mixture of exhaust gases.

So why is it such a treacherous place? The Iranian Energy Minister, Alireza Dayemi, has spoken out about the challenges of the project, including the high altitude, water pouring from the tunnel's walls and the chill factor. "These factors have made this project distinctively different from the similar projects and made the process of this tunnel's construction incomparable with the other similar ones," Mr Dayemi claimed.

SOURCE: news.com.au, 27 October 2015

A second Channel Tunnel?

The Channel Tunnel, actually three interconnected parallel tunnels, is so designed that trains can be diverted from one running tunnel to the other in two places under the sea, passing over or under a smaller-diameter service / emergency escape tunnel running between them. So a stalled train can be bypassed by diverting traffic from, say, the north tunnel to the south tunnel and then back again beyond the obstruction. All the same, depending on the single route is perhaps over-optimistic, and lorries on fire on transporter trains mid-Channel have resulted in all traffic being denied access from time to time.

Additionally, demand for crossings is rising. There has been a significant rise in freight and passenger traffic in 2015. Robert Brewerton has proposed that another three interlinked tunnels should now be driven to increase capacity and flexibility. He suggests a duplicate Channel Tunnel could be planned and completed in six years.

SOURCE: BREWERTON, Robert, 2015, Time for a new Channel Tunnel. *New Civil Engineer,* 10 September 2015

Tunnelled water supplies for Birmingham

Many of Britain's biggest cities lie in central or eastern England, whereas most of the rain falls in the west, especially in Wales and the Lake District. Not enough rain falls on Birmingham (or on London for that matter) to satisfy the needs of their populations. Historically, Birmingham's water has come from the five Elan Valley reservoirs via a 117 km Victorian-era aqueduct. All the water flows downhill, falling 52 metres from the Welsh hills to treatment works at Frankley.

The aqueduct comprises brick or concrete-lined tunnels, masonry bridges over river valleys, and pipelines. A holding tank at Frankley can store about five days' supply for the city. Any aqueduct closure for maintenance requires it to be drained, which takes a day. On completion of work, it takes another day to refill. Consequently, there is a risk, in any emergency lasting more than three days, of Birmingham running out of water.

Resilience of supply is now to be provided by creating alternative routes for water from Wales, so that parts of the route can be taken out of service for maintenance, and by tapping additional sources from boreholes and from rivers. A material factor has been rising groundwater levels under British cities, a result of decreased industrial demand such as coal-fired electricity generating stations (there are now none in London, for example). The downside of the new scheme is that water from boreholes and rivers will not flow uphill, so pumping costs will be incurred and passed to consumers.

SOURCE: HINSLEY, Simon, 2015, Water: Birmingham Resilience Project: triple bypass. *New Civil Engineer,* 13 August 2015

Tunnelling to bypass sumps in Wookey Hole, Somerset

Amongst your scribe's (PWS) childhood subterranean adventures was a visit to the Wookey Hole show caves in the Mendip Hills. Well-remembered, as in many such visitor attractions, was the guide's statement that we had gone as far as possible without getting wet, but there was much more cave beyond which could be visited only by cavers.

The truth was, I learned later, that these innermost parts of the Wookey complex were not to be visited by 'common or garden' cavers, such as I later became, but cave divers! Splashing about and wading in cold water in caves, and climbing up and down underground waterfalls is one thing. Swimming underwater in caves flooded to the ceiling and surfacing from time to time in isolated air pockets, is another. On the way in, you may have perfect visibility through crystal clear water. But if swimming in has stirred up mud, swimming back out is more like navigating in thick brown Windsor soup!

King Arthur's beard in Chamber 20

Wookey Hole Caves Ltd, who own all the land above their show caves, have previously made at least one tunnelled bypass to allow the public to see one or two of these further chambers. Another was created by drilling and blasting from Chamber 9 to Chamber 20 during 2015. The 140-metre tunnel was made between May and July. Three tonnes of explosives and thousands of detonators were used to blast through a thousand tonnes of rock to reveal the spectacular new cave which is now the largest at the attraction. The new cavern features a stunning subterranean lake and breathtaking rock formations. One known as King Arthur's Beard is illustrated here. How the surveying was done by cave divers is described in some detail by Duncan Price.

SOURCE: PRICE, Duncan, 2015, Wookey Hole: tunnel to Chamber Twenty. *Newsletter of the Chelsea Spelaeological Society* 57 (7 – 9)

World's longest railway tunnel nearing completion, Switzerland

Once, if not even today, the tunnelled part of London Underground's Northern line claimed the honour of being the world's longest railway tunnel. That distinction will shortly be claimed by the new Gotthard Base Tunnel nearing completion in Switzerland. Your scribe (PWS), in the course of his first train journey through the original Gotthard tunnel *en route* to Naples, mistakenly thought that on emerging from the south portal he was now in Italy, which is not in fact the case. Bellinzona, on the sunny side of the main Alpine massif, was, and still is, in Switzerland.

The new Gotthard Base Tunnel (57 km) is due to have trains in service in 2016, and further south the new Ceneri Base Tunnel (another 15 km) three years later. This will allow an 'almost flat' rail route for through trains from Germany to Italy, no part of which will be more than 550 metres above sea level.

It is intended to take environmentally damaging lorry and other road traffic off the roads of Switzerland, and to reduce passenger train journey times between Zurich and Milan by one and a half hours. At its deepest point below the Alps the tunnel will run at a depth of 2.5 kilometres. So the new tunnel is around twice the length of the Channel Tunnel, and well over twice the depth of the Boulby potash mine shafts on the East Yorkshire coast.

A miner climbs on excavated rocks after a giant drill machine broke through at the Sedrun-Faido construction site of the Gotthard Base Tunnel. Photo Ingo Valgma

Apart from the two single-track bores, of 7.7 metres internal diameter, there are other associated tunnels and shafts, and flat-lying or gently-inclined access adits. The rock excavated from within the main tunnels has been taken out via the portals, via access adits in the northern and southern halves, and from two 800-metres-deep spoil-hoisting shafts nearer the centre. Two sub-surface stations with platforms are also provided within the tunnels, not for regular passenger use, but for staff service and emergency purposes. Cross-links between the running tunnels are provided every 325 metres.

SOURCE: SIMONI, Renzo, 2014, Gotthard Base Tunnel, Switzerland – the world's longest railway tunnel. *Civil Engineering* 167

Subterranea Britannica : Study Weekend Rome 6-9 May 2016

We're arranging a Sub Brit trip to Rome in May 2016, following a very successful attendance at the International conference held in Rome last year. We were able to make some useful contacts and our thanks to Roma Sotterranea for helping us gain access to some interesting sites.

For more information, please see the flyer enclosed in this edition of *Subterranea*.

Booking will be on 'mySubBrit', so you must have renewed your membership to come along.

Keep up to date with Sub Brit Events by choosing to receiving emails from the Sub Brit Forum – see Issue 39, page 24 of *Subterranea* for how to do this.

Cremation at West Norwood: The Catacomb Railway

Colin R Fenn

Charging bier or 'introducer' c1914, 3' 6" high with windlass-operated projecting rail. Hand-propelled using grab rails, on axles sized for metre-gauge railway track. Part of the patent Toisoul Fradet system. Photo Colin Fenn

In the early hours of 17 July 1944, a V1 'Doodlebug' flying bomb exploded atop the hill at the apex of West Norwood cemetery, badly damaging the Dissenters' Chapel that covered the crematorium. Cemetery office staff recently discovered plans dating from 1946 from the architect Alwyn Underdown RIBA to rebuild the Chapel. The proposal was to replace the building with one of a similar design, and the architect's drawings record the form of Sir William Tite's Gothic Chapel and the vaults beneath.

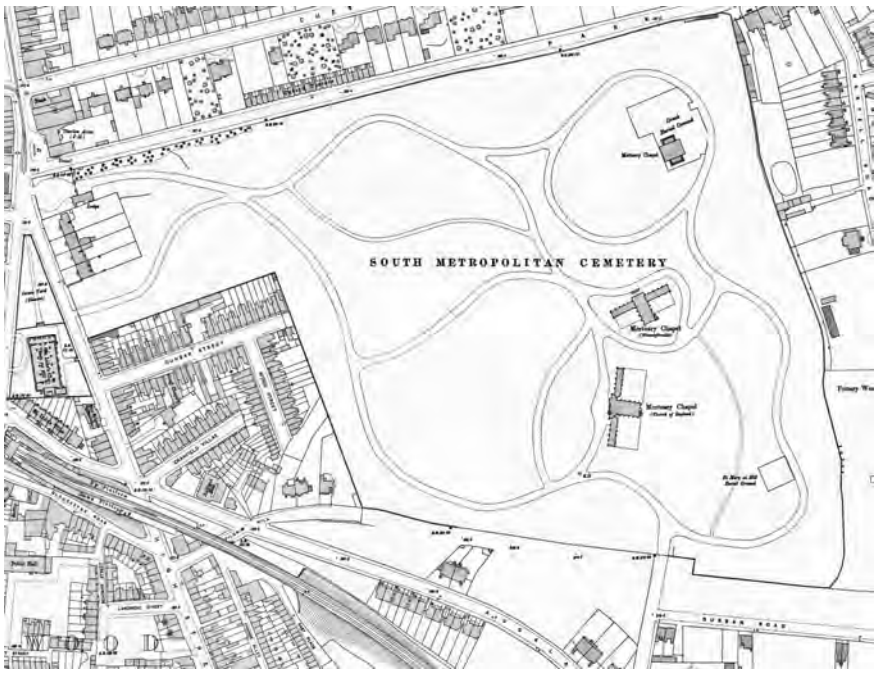
Unfortunately, those plans were never used: the remains of the chapel were pulled down and the present crematorium built in 1955 to a more modern design by the same architect. Only the crematorium chimney, dating from 1915, was left.

Nonetheless, the plans show that the catacombs below the Dissenters' Chapel were preserved, although the burial records suggest that these were never as popular for interments as the 90-bay Anglican Catacombs nearby, which hold 1,300 coffins. As it is smaller than those Catacombs, I sometimes refer to the Dissenters' crypt as the "Kittencombs". Just a few of its forty bays held coffins, which are walled-up and not visible today.

Underground railway

Exploration of the remains of the Dissenters' Catacombs has revealed a rusty bier in a disused bay. Two metal handles are handholds for pushing the iron trolley and it is clear that the trolley has wheels designed to run on a narrow-gauge railway track.

The top of the deck has rollers to ease the loading of a coffin. In the middle is a sliding metal tongue that was driven by a windlass on the left rear side, as a ram for pushing a coffin off the trolley. The size and weight of the trolley would have ensured that it was very stable when in use. The wheels are just over one metre apart between flanges, indicating a continental design, such as the



1895 5 feet to 1 mile OS Town Plan showing the layout of the South Metropolitan (West Norwood) cemetery. Catacombs were provided beneath both mortuary chapels. The Dissenters' Chapel is the northern of the two

lightweight, portable Decauville track, used extensively by trench railways during WWI.

The legal principles of modern cremation were established with the first crematorium in Britain, built at Woking in 1885. The crematorium at West Norwood was the first in south London (after Battersea Dogs Home). Designed in 1914, it incorporated the latest technology. The first cremator was installed by Toisoul, Fradet et Cie of Paris, a device described in the *British Medical Journal* of 21 January 1905:

> "Various forms of furnaces are used in the different crematoria in this country, which now number nearly a dozen. At Woking the Gorini system is in use, as in Italy; and at Manchester and Hull a form of the Siemens regenerator furnace, which is in vogue in Germany."

Siemens infamously supplied a modified version of its cremator design to the Nazi extermination camps.

The top of the 'Introducer' for the 1916 Lockwood cremator that ran on a narrow-gauge railway in the catacombs. Photo Colin Fenn

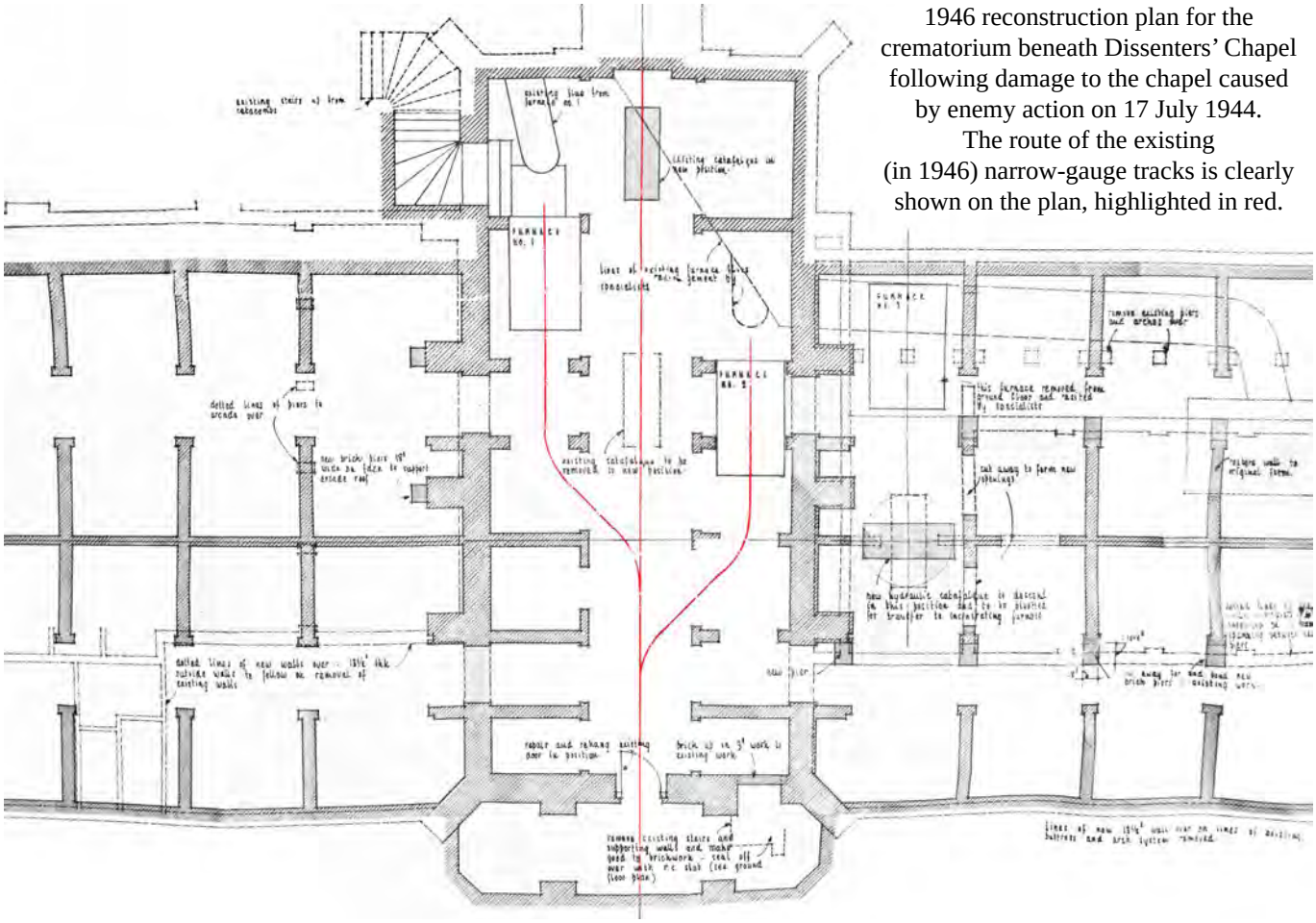
How it works

The Toisoul, Fradet cremator consisted of a low metal-skinned chamber on the ground floor of a 'crematory' built as an extension to the west of the original Dissenters' Chapel. A gas 'regenerator' (a type of secondary heat-exchanger) was constructed beneath the Crematory. The *BMJ* article continues:

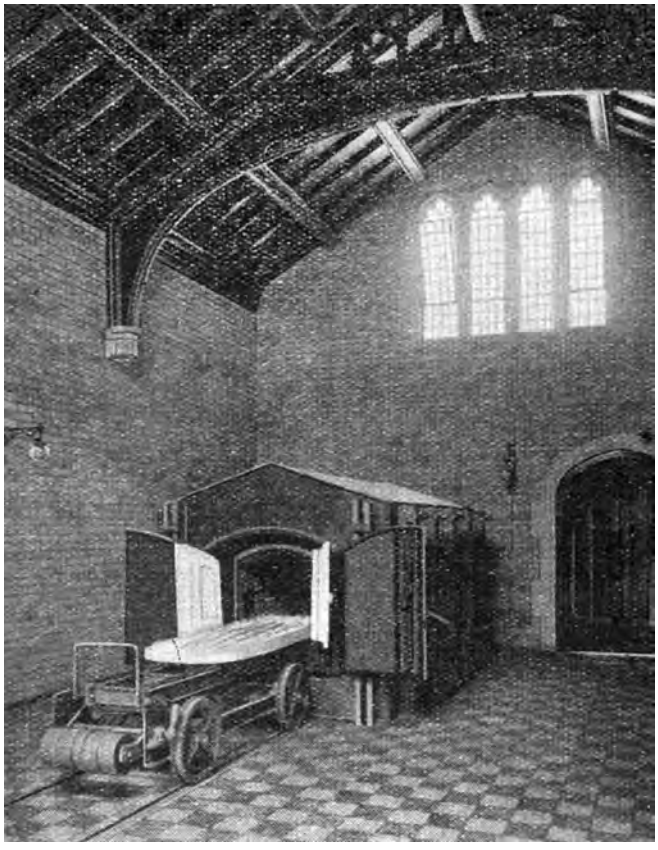
> "The incinerating chamber is vault-shaped, built of brick, and has two grooves in the floor in which the projections of the introducer slide. At the far end are the gas burners, eighteen in number, and on the Bunsen system. The gas is conveyed by a large main, and, in addition to the general control in the supply of gas to the furnace, each burner has its own regulating tap. At the sides of the furnace hot air can be supplied in graduated amount from the regenerator, a system of pipes, so arranged under the furnace, and in relation with its flue, that the heat from the furnace is employed to heat the air entering in this way.
>
> "The introducer consists of a trolley which runs on rails and carries the coffin from the chapel, and by a special arrangement of projecting rails places it with precision in the incinerating chamber. The tray on which the coffin rests is made of sheet iron. At the junction of the flue with the chimney is a large pilot gas-turner to secure an upward draught before the furnace is lighted. It is claimed that during the process the temperature can be regulated to a nicety by the amount of gas supplied, by the use of dampers, and by varying the supply of hot air from the regenerator; and it is guaranteed that, starting with Norwood Crematory and Dissenters' Chapel, the furnace cold, a body may be reduced to ash within five hours, with consumption of 10,000 cubic feet of gas."

The cemetery office at West Norwood keeps a register of cremations; not only does it list the details of the deceased and the certifying authority, but it also records the amount of gas used. It seems that once the furnace was in continuous use it would mainly use 'regenerated' hot air, requiring only 1,500–2,000 cubic feet of gas per cremation. A separate register recorded the amount of smoke produced.

Although the Toisoul, Fradet device was efficient, more capacity was needed and the South Metropolitan Cemetery (SMC) Company Secretary, Arthur Charles Lockwood, designed an improved furnace, based on a steel-ribbed brick chamber with a vertically sliding square door. It featured a separate tray below the chamber for the tidy removal of cremated remains, and had burners the whole length of the chamber.



1946 reconstruction plan for the crematorium beneath Dissenters' Chapel following damage to the chapel caused by enemy action on 17 July 1944. The route of the existing (in 1946) narrow-gauge tracks is clearly shown on the plan, highlighted in red.



Toisoul, Fradet cremator in original position c1915

The design was sold to other cemeteries, and a historic Lockwood cremator can be seen in the visitor centre at Arnos Vale Cemetery, Bristol. This compact design was installed in the catacombs besides the original Bramah (!) hydraulic catafalque. Ironically this catafalque, the existence of which has been largely forgotten, has had much greater use than the one in the Episcopal Chapel. The larger catacombs beneath the now demolished Episcopal Chapel were visited by members of Subterranea Britannica in 2010 and 2014.

The SMC used the catafalque inside the Dissenters' Chapel to discreetly lower the coffin from sight of the mourners to the cremation furnace. This showed great sensitivity, as rival crematoria had designs that required the coffin to be placed directly onto rollers that led straight towards the furnace. Such unsubtle methods are probably what inspired the poem *The Song of the Strange Ascetic* (G K Chesterton, 1913).

If I had been a heathen, I'd have piled my pyre on high.
And in a great red whirlwind, Gone roaring to the sky.
But Higgins is a Heathen, And a richer man than I;
And they put him in an oven, Just as if he were a pie.

The preserved engineering drawings reveal that the loading doors and rails inside Lockwood's furnace were 3' 4" above floor level, matching the height of the trolley that remains in the Catacombs. So there we have it: the rusty bier was an 'introducer' for the 1916 Lockwood cremator that ran on a narrow-gauge railway in the Catacombs. This discovery now explains the mysterious dashed lines drawn on plans of the Catacombs: the dashed lines indicate the route of the tracks!

Engineering drawings show that the Lockwood design

had been improved by Young & Co, and a second cremator had been installed by the early 1930s. Underdown's 1946 plans called for the Bramah catafalque to be relocated further back towards the chimney on the south wall. The then extant 'marshalling yard', with perhaps 90 feet of track, would be slightly extended to carry coffins from the catafalque to two furnaces inside the catacombs. The original Toisoul, Fradet cremator would be removed from the crematory hall, which would become a smaller 'family hall' with pews for services.

Entrance to the crematorium/catacombs. Photo Colin Fenn

A new electro-hydraulic Collis lift was to sit in a turntable to raise and lower a second catafalque into this hall, and a third furnace was to be installed in the catacombs. However, it took some years to implement these plans, with the third cremator being replaced by a Radiant Heating Ltd. model in 1956. Incorporating remote controls and electric blowers for safety and efficiency, it became the main cremator in use.

Weight limit

Between 1968 and 1971 both Lockwood cremators were removed, the Bramah coffin lift demolished, and a 'Diamond' cremator installed by J G Shelton & Co. to work alongside the Radiant. More recently, the catacombs were fitted with more efficient equipment, including a state of the art furnace and an air blast cooler to clean mercury and other toxins from the exhaust fumes. However, the Collis electro-mechanical lift of 1955 remains in place to lower the catafalque from the main hall. It still functions, albeit noisily, but is limited to bodies of no more than 20 stone. Heavier bodies must go to other crematoria.

A spare wooden catafalque top with its rollers is also stored in one of the vaults, probably removed from the original Bramah coffin lift. This would be useful for our long-planned restoration of the Anglican catafalque. We are also looking out for historic Decauville railway track so that we can restore and demonstrate the introducer trolley.

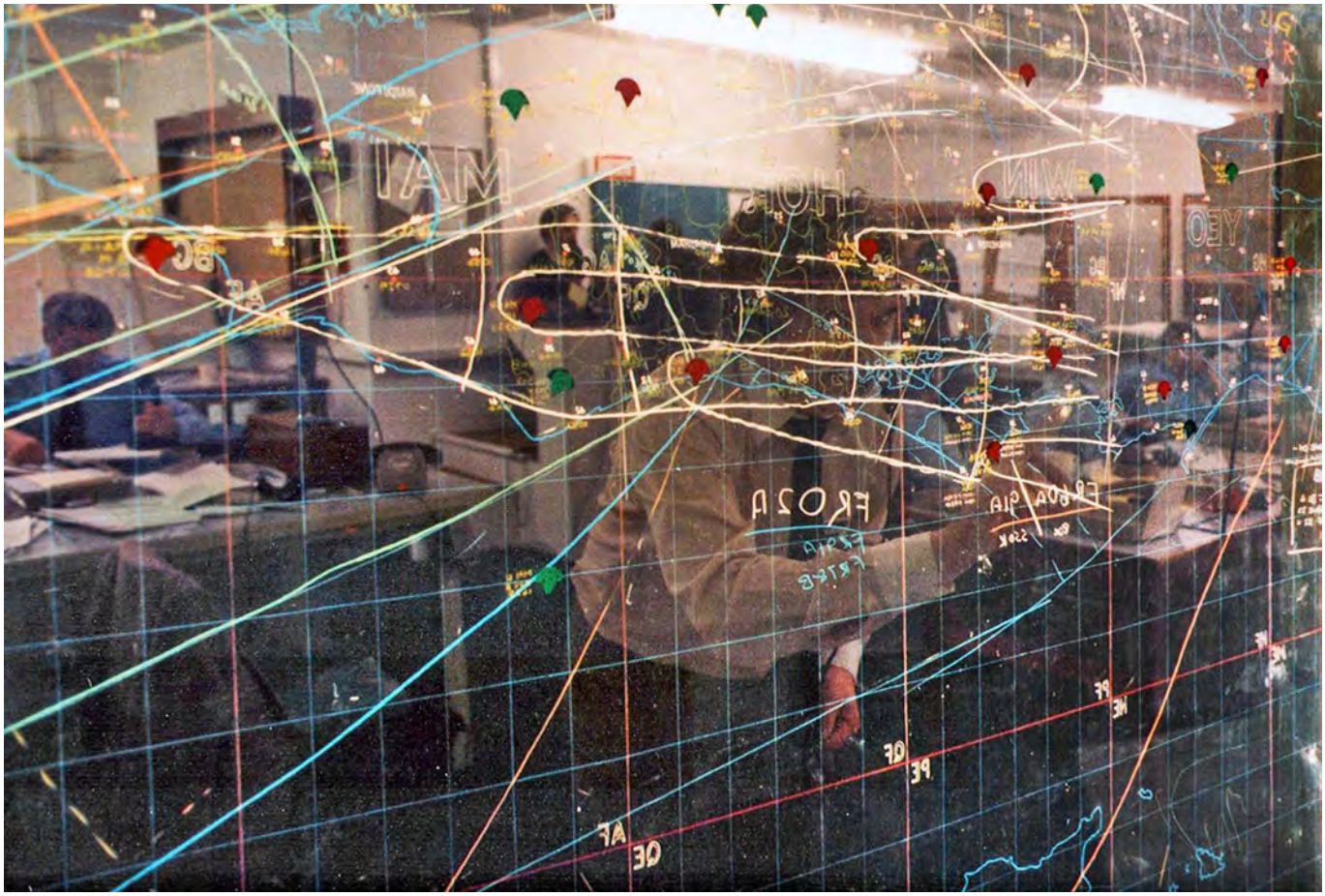
There is an article about the Toisoul, Fradet cremator installed at Leeds in the *Undertaker's Journal* 1905: 6. There is also a description of this cremator in *Resurgam* 1988; 41: 1519.

In a curious twist to the tale, we have discovered that the first western cremator in Asia was a similar Toisoul, Fradet furnace that was installed in Calcutta in 1903. It has not been used since 1980, because they were encountering gas supply problems. We have sent them copies of our engineering drawings as the Christian Burial Board of Kolkata recently announced plans to restore it as a working heritage crematorium.

The Dissenters' Chapel

Royal Observer Corps Group Controls

John Shere (ROCA Heritage Team and ex-ROC member)



No 2 Group Control Horsham during an exercise. An ROC Display 'A' Plotter's view of the Ops Room. Photo Bob Pickwoad

Following on from my article about Nuclear Reporting Cells (NRCs) in *Subterranea* 39, this piece covers the ROC Group Controls that operated throughout the Cold War.

Up to 1991 the volunteers of the ROC served in one of three types of locations. These were Posts, Group or Sector Controls and NRCs. Most people only ever think about ROC Posts (if they have heard of us at all!). This is logical as Posts were the 'field force' of the ROC and involved the largest number of people. By 1991 there were 870 Posts and only 25 Group or Sector Controls. The number of NRCs was even less.

Joining Up

Training for those serving in these three types of locations was surprisingly completely separate and used different training manuals. In fact we rarely met ROC people operating in the other specialist roles. My own service was short in comparison with many others; I served for nine years at the No 7 Group – Bedford Group Control and a further four years at the NBC (Nuclear, Biological and Chemical) Cell (NBCC 6) at RAF Brampton.

When I was thinking about joining the Corps it was suggested I may be better serving at the Group Control and this was a decision I was always grateful for. I joke that having served in the RAF I liked my creature comforts and keeping warm. This is partly true but I also preferred all the technical aspects of Group Controls.

Even in WWII there were 'filter' locations where Posts sent their information; it did not go directly to the RAF. In the early days these were called Observer Corps Centres and, in 1941, became ROC Centres. As a result, older ROC people often referred to Cold War Group Controls as 'Centres'. They were also known as Ops Rooms. These WWII Centres filtered all the information from Posts and only then fed the key information to RAF Fighter Command locations such as RAF Uxbridge, and Bentley Priory.

Only one original WWII ROC Centre is still remaining; this being the one that was found a few years ago hidden from view inside the Guildhall at Bury St Edmunds. This is England's oldest civic building and was visited by some Sub Brit members for a special open day in October 2014. For the full interesting story of this see *Subterranea* 36 (August 2014). You can also see more about this location in the short video on their website: www.buryguildhallexperience.org.uk. These ROC Centre/Ops Rooms locations were also used as the Group Headquarters offices as well.

Going Underground

At a conference in 1955, it was agreed that the ROC should undertake fall-out reporting as a secondary role to that of aircraft reporting. Decisions were made quickly during this Cold War era because as early as May 1956 the Home Office had laid down a programme for the building of 1,563 Posts and 31 Centres. The new Centres were of two types: semi-sunken and surface. Each Control would have stand-by generators, air-conditioning with filtration, communications, operating areas, sleeping accommodation, and kitchens.

The cost at this time now sounds very modest at £45,000 for semi-sunken and £41,000 for surface structures. Some locations were converted Army or RAF Operations Rooms. For example No 12 Group (Bristol) and No 31 Group (Belfast) were ex-Anti-Aircraft Gun Operations Rooms. Disused RAF Sector Ops Rooms were utilised for No 30 Group (Inverness) and No 21 Group (Preston).

The original Groups were:

No 1 Group Beckenham
No 2 Group Horsham
No 3 Group Oxford
No 4 Group Colchester
No 5 Group Watford
No 6 Group Norwich
No 7 Group Bedford
No 8 Group Coventry
No 9 Group Yeovil
No 10 Group Exeter
No 11 Group Truro
No 12 Group Bristol
No 13 Group Carmarthen
No 14 Group Winchester
No 15 Group Derby
No 16 Group Shrewsbury
No 17 Group Caernarvon
No 18 Group Leeds
No 19 Group Manchester
No 20 Group York
No 21 Group Lancaster
No 22 Group Carlisle
No 23 Group Durham
No 24 Group Edinburgh
No 25 Group Ayr
No 26 Group Glasgow
No 27 Group Oban
No 28 Group Dundee
No 29 Group Aberdeen
No 30 Group Inverness
No 31 Group Belfast

The exterior of the new buildings was a white colour finish. It was typical of this period to use white anti-flash paint and some readers will recall that the RAF V-bombers were originally painted white. A good example of an early ex-Group Control in this original colour scheme is the one at Watford. This is now used by a veterinary practice for storage and was visited by Sub Brit in July 2012. This picture shows some well-known Sub Brit members heading towards the entrance from the rear of the veterinary practice.

Photo John Shere

Technology Advancements

The building structures themselves changed very little from when they were built until 1991 when they became disused. The only external difference was that the colour changed to dark green and different aerials were mounted on the radio mast. However the equipment inside had undergone major changes as a result of new improved technology.

The original data communications equipment was based on noisy teleprinters and paper-tape; when I first joined Bedford, they were still using this old equipment. I only did one exercise when this was used and working in the 'Tape Centre', as it was called, I could imagine what it was like working in a textile mill. Long springs mounted vertically were used to hold messages on paper tape. Luckily for me the new technology arrived very quickly.

The new MSX Message Switch SX2000 system used an advanced computer system with silent teleprinters and VDUs. It was housed in a solid metal case and was also EMP (electromagnetic pulse) -proof. These were part of the national ECN (Emergency Communications Network) which will be explained in detail later. Each Control also originally had a small telephone PBX switchboard which was manned during operations. This was later replaced with a fully automatic PBX digital system which had a single VDU to operate (supervisor mode) and which did not need a dedicated operator.

The number of ROC Posts and Group Controls was reduced as a result of a major defence review in 1968. Some of the early WWII surface Controls were no longer in use, having been replaced by the newer standard semi-sunken design as shown in the picture above. However a few surface buildings still remained.

No 8 Group: Coventry Group Control in the white finish.
Photo Bob Pickwoad

The total number of Posts was reduced to 875 and Controls went down to 25. This total, and a reduced manpower, was to remain much the same for the next 23 years. One exception is that the Group Control in Truro closed in 1973. The ROC also still remained the key element of the UKWMO (United Kingdom Warning & Monitoring Organisation) until 1991.

No 7 Group: Bedford Group Control on the opening day in 1964 – also available in white c1964. Photo Gary Crocker

No 2 Group Horsham Sector Control after 1991. This is an example of a surface building; the new Sector/Group control room seen on the right was added in 1972. Photo Nick Catford

The final 25 Group and Sector Control locations were:

Metropolitan Area

No 1 Group Maidstone

No 2 Group **Horsham Sector Control**

No 3 Group Oxford

No 4 Group Colchester

No 14 Group Winchester

Midland Area

No 6 Group Norwich

No 7 Group Bedford

No 8 Group Coventry

No 15 Group **Lincoln Sector Control**

No 20 Group York

Southern Area

No 9 Group Yeovil

No 10 Group Exeter

(No 11 Group Truro – closed 1973)

No 12 Group **Bristol Sector Control**

No 13 Group Carmarthen

No 16 Group Shrewsbury

Western Area

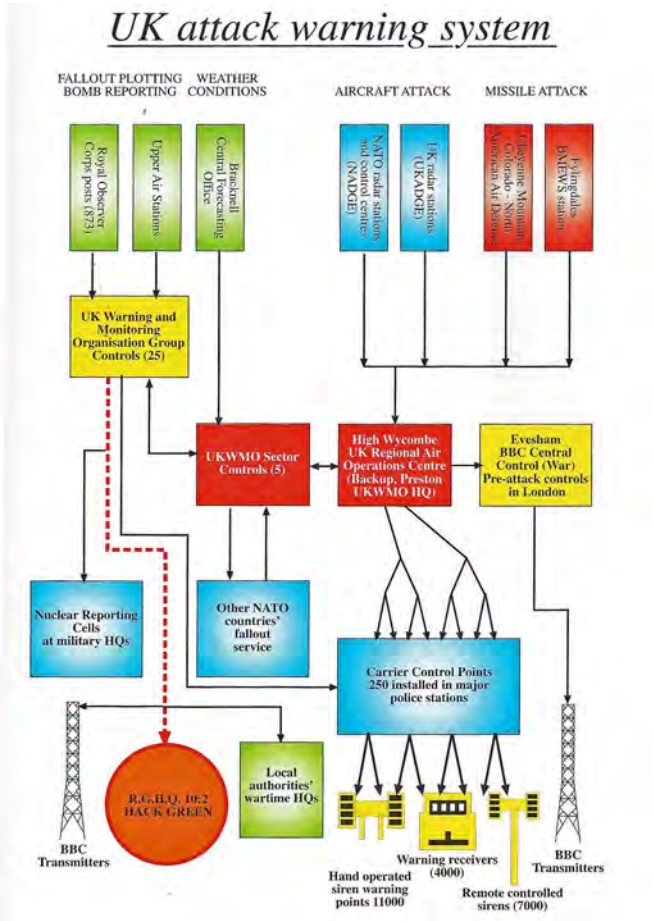
No 17 Group Wrexham

No 21 Group **Preston Sector Control**

No 22 Group Carlisle

No 23 Group Durham

No 31 Group Belfast


UK attack warning system
FALLOUT PLOTTING BOMB REPORTING
WEATHER CONDITIONS
AIRCRAFT ATTACK
MISSILE ATTACK
Royal Observer Corps posts (873)
Upper Air Stations
Bracknell Central Forecasting Office
NATO radar stations and control centre (NADGE)
UK radar stations (UKADGE)
Fylingdales BMEWS station
UK Warning and Monitoring Organisation Group Controls (25)
UKWMO Sector Controls (5)
High Wycombe UK Regional Air Operations Centre (Backup, Preston UKWMO HQ)
Evesham BBC Central Control (War) Pre-attack controls in London
Nuclear Reporting Cells at military HQs
Other NATO countries' fallout service
Carrier Control Points 250 installed in major police stations
R.G.H.Q. 10:2 HACK GREEN
Local authorities' wartime HQs
BBC Transmitters
Warning receivers (4000)
Hand operated siren warning points 11000
Remote controlled sirens (7000)
BBC Transmitters

The significance of the ROC in the UK Air Attack system role can be seen in this diagram. Courtesy Rod Siebert, Hack Green Bunker

Caledonian Area

No 24 Group Edinburgh

No 25 Group Ayr

No 22 Group **Dundee Sector Control**

No 29 Group Aberdeen

No 30 Group Inverness

Before we venture underground it should be noted that these sites were also the office headquarters of the Groups and the secure compound containing the Group Control also had surface buildings for the office staff and stores. Some of these above-ground locations were based around the original WWII ROC Centre buildings.

Each Group HQ also had a small number of full-time staff who were responsible to the HQ ROC staff at RAF Bentley Priory:

- Whole time ROC Observer Commander as Deputy Group Commandant
- Whole time Observer Lieutenant as Group Staff Officer
- Civilian Administrative Officer (Civil Service)
- Cleaner/handy person (could be part-time)

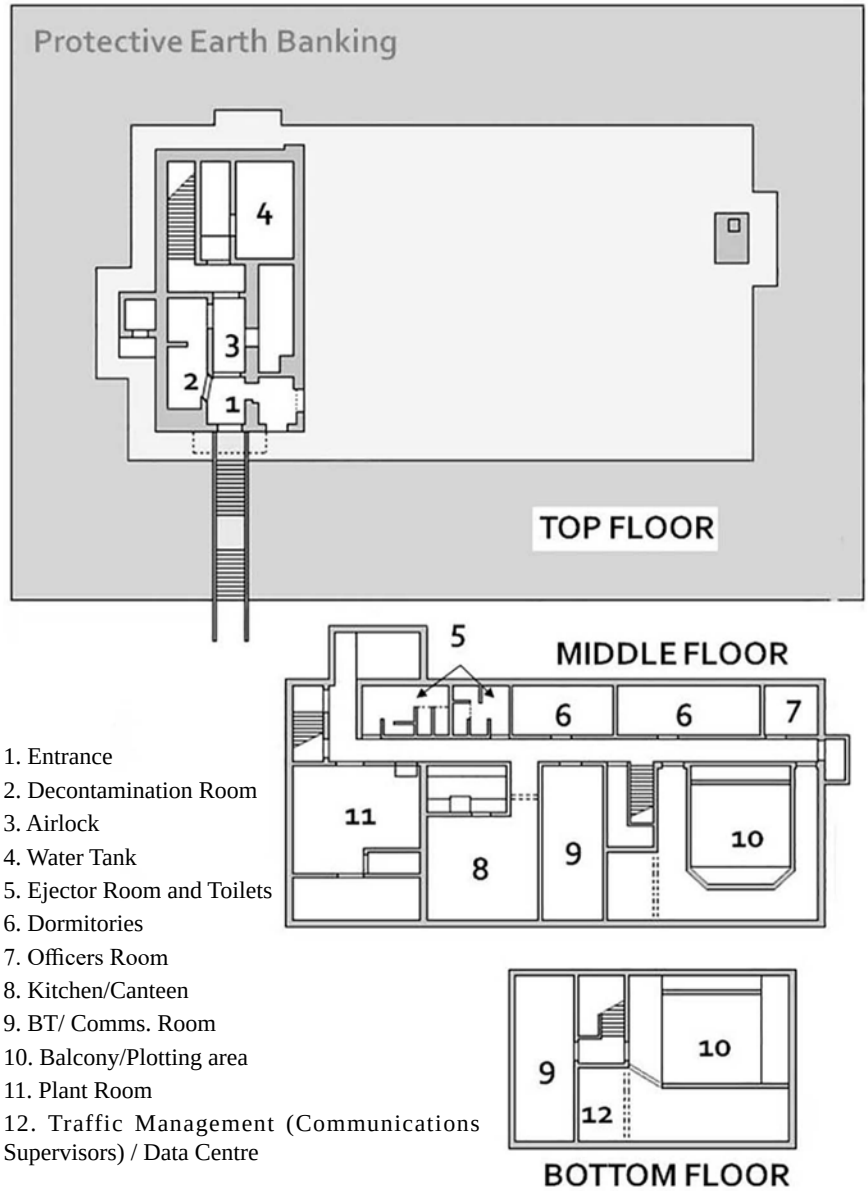
They looked after day-to-day running of the Group including recruitment, maintenance, repairs, supplies and inspections of Posts etc.

The buildings at my own Group HQ (Bedford) included offices, classrooms, a presentation room, kitchen

plus storerooms for equipment and food. The old WWII observation area was located in the centre. We sometimes used the classrooms for training on a crew night.

Not well-known was that a few of the old Group Controls were kept for a number of years after 1969 as stand-by operational buildings. Their official titles were STCs (Secondary Training Centres) as they could also be used for training. They had no staff and one of these was at Derby which had exchanged roles with Lincoln in 1968. Derby was kept largely unused until 1974, being one of five locations that were not released from ROC use until after 1970.

Let me now describe a standard sub-surface three-level Group Control building as it was in 1991. A good example that you can visit is the one at York which is owned by Historic England (English Heritage). This three-level building looks exactly the same as the one that I served in at Bedford. They were made of a one-metre-thick reinforced concrete shell with a large banked covering of soil.



1. Entrance
2. Decontamination Room
3. Airlock
4. Water Tank
5. Ejector Room and Toilets
6. Dormitories
7. Officers Room
8. Kitchen/Canteen
9. BT/ Comms. Room
10. Balcony/Plotting area
11. Plant Room
12. Traffic Management (Communications Supervisors) / Data Centre

Standard semi-sunken Group Control (Cocroft & Thomas/Simon Craine)

Aztec Temple

Oddly, you had to go up steps to reach the Group Control top-level entrance. This sometimes led to the nickname 'Aztec Temple'. At ground level to the right was the radio aerial tower; this was only to be used post-attack and the multi-stage lattice mast sections were raised by an electric motor.

A view of the ejector room at Watford. Photo John Shere

The large main steel door led into the entrance area; on a weekly training evening (or prior to an exercise) this door was controlled by a Crew Security Team Observer. Once everyone had entered it was then locked on the inside. Any latecomer had to ring the door bell and wait for a begrudging Observer to go upstairs to let them in!

Inside the top level to the left was a basic decontamination room reached by an outer air-lock dressing room to enable you to leave your contaminated clothes in a bin. To the right behind another thick steel door were the air filter banks. These could be switched into use from the plant room below to remove contaminating fallout. There was also a radiator room housing the cooling fan and radiator for the stand-by generator.

Beyond another door was the top balcony and stairs leading down to the main level underground. If you looked upwards you would see the chain hoist used for installing and removing large machinery. Not easily accessible but in this area were the large tanks containing diesel and fresh water. The diesel engine fuel was supposed to last us forty days in continuous use.

On descending the stairs you would reach the long main corridor. First on the left is the door to the ejector room.

Two large pressure vessels stored our waste water and sewage; using a clever

system involving valves and air compressors each one, when full, would be discharged onwards and upwards into the outside world under pressure. In our Crew (Crew 3 – Bedford) we had a highly skilled plumber (L/Obs. Paul Sawford) who had studied how this system worked. If we had ever been called to use our skills for real in a nuclear exchange, then it was hoped that he would be with us!

I had never seen it fail but the thought of it failing was not good. Maintenance challenges were eased by having duplication of equipment in this area and in the plant room. It was typical in Crews that we all understood people's particular skills in case they were ever needed.

On the right-hand side was a large door to the plant room. This contained the life-support systems of air conditioning, pumps and electrical power supplies etc. The air conditioning could be operated in a number of modes:

- Normal – the outside was air cooled by air conditioning.
- Modified – where the air conditioning was switched off.
- Recirculation – outside air blocked off and the air reused.
- Filtration – in this mode the outside air would be passed through the large aerosol filters to remove the particles of fallout. This mode needed careful monitoring because to prevent contaminated air getting into the building, the air inside was held at a higher pressure than outside. A manometer was fitted to monitor this pressure.

The air system always seemed to work well and later I realised how clever it was. Air was moved at high rates with the recirculating fan moving this at 4,500 cubic feet/minute. The main corridor was used as the return path back into the mixing chamber. This small room was located inside the plant room and could be mistaken, if you didn't know better, as an empty store cupboard!

The air-conditioning system in the Plant Room at No. 13 Group South Wales. Photo Nick Catford

The standby generator at No. 13 Group South Wales. Note ceiling-mounted extinguisher nozzles. Photo Nick Catford

Gas Gas Gas!

The large diesel generator was housed behind a door at the rear of the plant room; the engine was designed to start automatically if the grid failed. This could have been a fire risk to us underground so special measures were taken. Inside the door a steel shutter was held high above the entrance way – I was always wary being in this room as the equipment was fitted with a number of steel wires under tension connected via pulleys. In the event of a fire, links would break and the steel wires would move shutting off the fuel supply, dropping the steel shutter under its own weight and opening a CO2 gas cylinder. This was not a good place to be standing unless this mechanism was made safe.

Moving down the corridor on the left you would pass the male and female toilets to reach the male and female dormitories. These contained six two-tier bunk beds for female staff and four for male staff giving twenty beds in total. For operations the lights could be dimmed to a low level.

We used these dormitories for 'hot bunking' during long exercises; I never saw a problem with this. When you have had a long period of duty and are sent for a few hours sleep you first had to wake a named person in a bunk and get into their bed (for clarity, once the original occupant had exited!). If you are really tired then climbing into a warm bed is a bonus to getting some sleep. On the right-hand side was the door to the BT frame room which contained all the telephone and radio connections plus the radio and data/telephone exchange switching equipment.

Another important room on the right before reaching the lower level balcony was the rest room and kitchen. The kitchen was well equipped with large fridge, oven, toaster and microwave; we even had a waste disposal unit fitted under the sink. In the event of a real situation the full-time Group Control officers would formally requisition fresh food during the TTW (Transition to War) phase. We would use this first and then use our ration packs which were very good.

A more recent picture showing the canteen and kitchen serving hatch. This is at the restored No. 28 Group Dundee Sector Control at Craigiebarns. Photo Colin Johnson

The ration packs and extra jerrycans of fresh water would be stored all along the corridor. The rest room was also used for training and around the walls were 'patch panels' which connected to the Post Display Plotter positions. From these points we could run simulated mini-exercises without needing Posts to be manned. If anyone was a dedicated smoker, a Group Control was not the place to be! There was no smoking inside the rest room or in any other part of the building and during training, exercises or the real thing you were locked inside.

There was always friendly banter between Post Observers and Control Crew Observers when we met, which was not very often. The Posts thought we could have a hot cup of tea and a biscuit whenever we wanted. In reality this was not the case. On exercises or the real thing you would be sent to man a position and you could not move away until someone replaced you sometimes hours later. So in reality it was easier for Post personnel to take a break but much more difficult for them to make the tea. In truth, we both respected our opposite numbers.

The final room on the left was an office used by senior staff. A board kept up to date by an officer would show numbers of staff and the status of the Group Control life support systems. This would include the levels of water, diesel and food. Just beyond this was the entrance door up to the emergency exit. This was never opened unless there was a real or practice incident.

Nerve Centre

Going back to the entrance to the balcony, you would step into the nerve centre of the Control. The key information came from the Group field force which, of course, was all the ROC Posts. On the first part of the balcony a row of normally five or six Post Display Plotters were seated; they were in direct contact with the Posts. Normally, each Plotter controlled and received information from two Clusters (six to eight Posts in total).

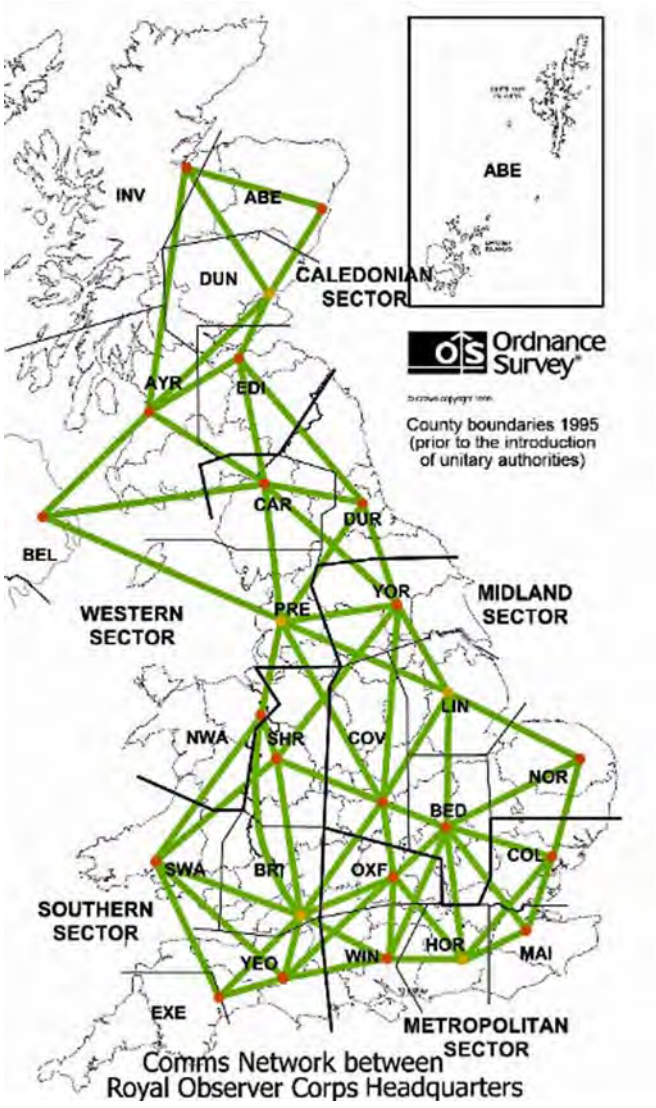
Every five minutes the Plotter would contact each Post in turn through a dedicated phone line. By pressing the 'Transmit' button on a Post's Tele-talk box there was instant communication with the Plotter; no dialling of

Post Display Plotters at No 7 Bedford receiving constant information from Posts and recording details onto Post Display Boards. Photo John Shere

numbers was required at either end. These dedicated lines from BT were understood to be one of the biggest costs of the UKWMO. In the event of a line failure after the attack phase, radio communications could be used to contact Master Posts (one in each Cluster of three or four) from the same positions. The Post Display Plotters would do a communications check with each Post every 5 minutes and mark the display 'CC' in black against each one (if OK). The board in front of them would then be rotated. Every 10 minutes they would call each Post again and any radiation readings would be updated before being rotated again. Important information such as First Fallout would be marked in red eg 'FF' plus the time. Once on operations or exercise the Post Display Plotters could not leave their position until someone replaced them. Any information such as important information for Triangulation, had to be passed to an orderly who stood behind the plotters.

The view across the balcony to the Post Display Plotters at Horsham Group Control. Photo Bob Pickwoad

Just before moving down to the far end of the balcony and the triangulation alcove you would see that one Post was numbered as '99 Post'. There were never as many as 99 Posts in a Group so how could this be? Often not realised is that Group Controls also acted as a Post in their own right.

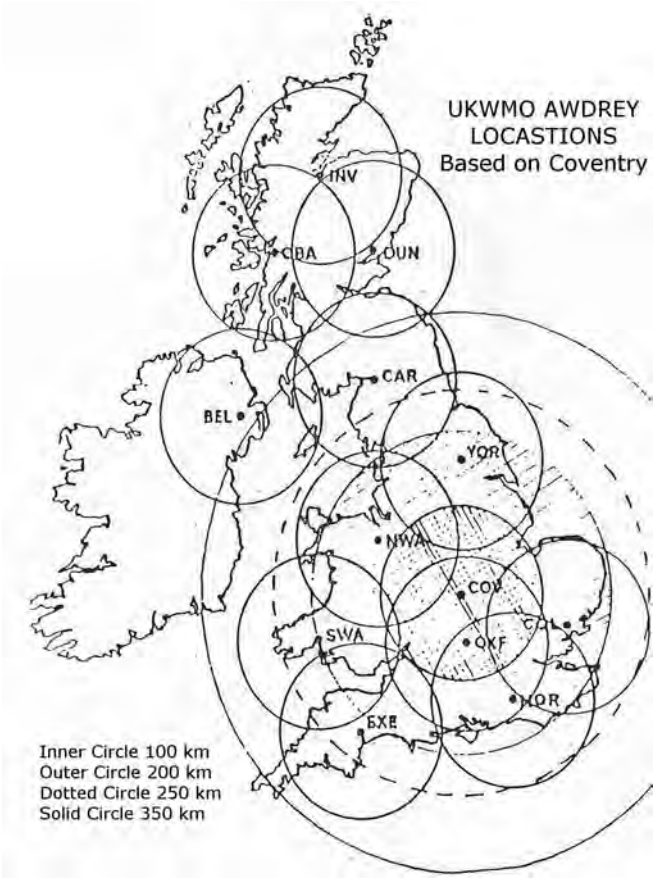


From Steve Scanlon

They had a full set of instruments (GZI, BPI & FSM) which were set up as in a standard Post. The GZI (Ground Zero Indicator) was on the roof above the main door and the FSM (Fixed Survey Meter) dome and BPI (Bomb Power Indicator) baffle plate would be on top of the grass mound above the Triangulation area. These last two instruments were fitted on the right wall so that the triangulation team had a good view of them.

Another instrument fitted into only thirteen of our Group/Sector Controls was AWDREY (Atomic Weapon Detection Recognition & Estimation of Yield). This was an automatic reading electronic instrument with a minimum range of 75 miles so the chosen sites covered the whole country. Although very clever it could be triggered in storms by lightning flashes.

York was equipped with an AWDREY which was located on the balcony near Triangulation. Those who have visited Exeter Control (10 Group) may have seen that one of the sockets is still labelled up for AWDREY. The system did not have to be watched because when triggered it produced a paper print-out. The outside sensor for this can be seen on the left of the main door on top of an air intake plinth. It looks like a metal chimney.



The old Group Control at Oban in Scotland was used by an NRC Team until 1992. Here, there was a plan to provide an extra capability to AWDREY. This was to give automated rapid triangulation bearings and consequently the ground zero location of a burst. These bearings were to come from an additional unit called DIADEM (Directional Indication of an Atomic Detonation by Electromagnetic Means). This development was stopped as the system needed three masts at 300-metre spacing which it was realised may not have had the ability to survive attacks.

The Triangulation alcove which was dominated by a special table was a unique area. For me, being part of this team was one of the best roles in an exercise. It took a mixture of good teamwork, high skill levels and a bit of magic to quickly and accurately work out location, bomb power, height and type of a nuclear burst. Triangulation Supervisors always tried to get the best people for their team!

The view from Triangulation in Horsham. Photo Bob Pickwoad

Group Controller

The UKWMO Group Controller sat at the far end of the balcony and was usually also the ROC senior officer. They were like the captains of a ship as they had the best view of everything that was happening. Moving round to the far side of the balcony was the Leading Observer – Post Supervisor, who sat facing the Post Display Plotters. This was a busy role. He or she had to deal with problems at Posts, make sure the Plotters were doing everything correctly and in fallout conditions have to control the Posts' ventilation. The Posts could not have their hatches permanently closed.

There were two other Observer positions facing the Plotters. The first one (without a VDU) was the Log Chart Teller; every ten minutes they passed fallout readings to a Plotter below who marked the information onto logarithmic scaled sheets. Finally on the balcony was the VDU Operator who had to input important information such as bomb burst details or first fallouts into the MSX Message Switch. From this position the SX 2000 system would automatically route this information all around the country to all the customers who needed it including all other Sector/Group Controls.

The Traffic Management Team monitoring the flow of all messages through the Message Switching System (MSX). No 7 Group Bedford. Photo John Shere

Oxford Group Control showing Post Supervisor, Log Chart Teller and VDU Operator. On the lower level is the Warning Keyboard Operator plus Display A & B.

In the right-hand corner at the bottom of the stairs was the Traffic (Communications) Supervisors area. They were always busy running the Data Centre and sat behind a VDU and printer. There was not a lot to see, but we were transmitting and receiving data to and from the whole country. The team had to monitor this flow of messages.

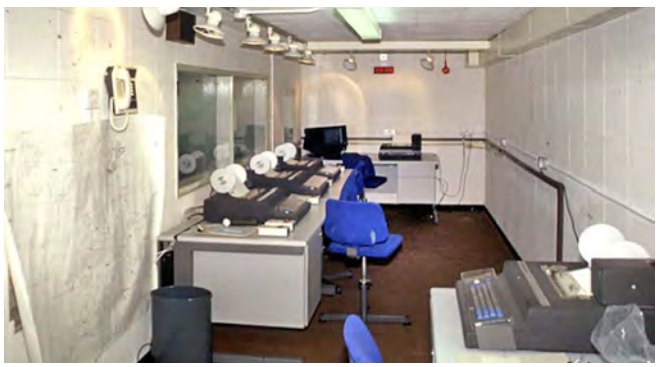
The MSX 2000 (Message Switching Exchange) computer system was part of the national ECN (Emergency Communication Network), implemented in 1984. This was a fully automated switching network for data messages; this system was separate to the public network but was managed by BT on behalf of the Home Office.

These advanced systems were updated in 1988 to the SX 2000S (S for Special). They linked key establishments together including ROC Group/Sector Controls, Regional Government Headquarters (RGHQ), government departments, council HQs and the emergency services. The system was fault-tolerant and in the event of external line failures the data could be rerouted around the country to ensure it reached the required customers. For more details see: www.ringbell.co.uk

The main part of the Data Centre was a room sectioned off in the area of the rear wall. This contained a row of teleprinters and another two data input VDUs and these were manned by Observers plus another Supervisor. A long window looked out into the main area and from this location Observers (Tellers) read out the details from the printers and told the information to Plotters who were manning the displays.

The writing is on the wall (backwards!)

The two main large displays were vertical Perspex boards known as A and B. As Plotters worked behind these displays they would have to use their 'we could write backwards' skills to write onto these displays. Once a Plotter had



A view of the No 7 Group Bedford Data Centre taken in 1991. This was the main area for receiving information. At the rear a 'Miscellaneous VDU Operator' was also positioned to send out messages. Photo Gary Crocker

A view down into the data centre window from the balcony at No 31 Group Belfast taken during the last INTEX (NATO International Warning and Detection Exercise) in April 1991. Photo from 31 Group ROCA Heritage Team

A view showing the Log Charts. A Carrier Receiver can be seen mounted on the wall to the right. This is also No. 31 Group Belfast and the door on the right shows that this was not a standard building.
Photo from 31 Group ROCA Heritage Team

finished putting up some information they would tap the board with their chinagraph pencil to alert the UKWMO Warning Officer working on the front of the display.

The Warning Officer would be plotting fallout plumes and working out future warnings. Looking into the lower area again from the rear towards the big display, the Log Charts (named after the A3 logarithmic vertical scales for radiation levels) displaying fallout readings were all along the right-hand wall and two smaller other displays 'T' and 'E' were on the left wall. These two displays showed us the whole of UK (T) and continental bursts (E).

In the back corner as part of the data centre was where the data communications were controlled. As well as having a data control VDU, these supervisors also had a white-coloured VDU which was the telephone switchboard. An important black keyboard was located on the table of the working area; this was the Warning Keyboard and an Observer at this location could contact any of our CCPs (Carrier Control Points) which were located in major police stations such as, Bedford, Cambridge, Edgware, Hertford and Northampton.

Warning messages would be sent such as 'Fallout Warning Black'. These would then enable sirens to be set off to give early warning to the public of the approach of fallout in designated 'Warning Districts'. I noticed on a visit to the York Group Control run by EH that they did not have a Warning Keyboard. When I contacted EH about this they said they did not know what had happened to the original one and did not think that anyone would notice it was missing!

Members of the Warning Team determining the areas to be warned, via the Warning Keyboard, of approaching fallout. To the right the Log Charts are being plotted.
No 7 Group Bedford. Photo John Shere

Manning Levels

Each Group Control had three Crews. At Bedford, Crew 1 met on Monday evening every week for training; Crew 2 met on Tuesday and I was part of Crew 3 which met every Wednesday evening. As a result we rarely met the other crews unless there was an exercise.

Would it have worked for real? We only needed one and a half crews to operate for real and then the big steel door could have been closed! As described in my last article we all had plans for our families and took our ROC role very seriously. I do not think we would have been short of numbers to operate. Our training was very professional we were trained to operate in all the roles and positions within the Group Control.

Of course Supervisors and Officers had extra skills but we did practise exchanging these roles around during exercises. Each Crew had all the ROC skills to run the Control but we needed the Warning Officers, extra Observers and Supervisors to be able to run 24 hours a day for long periods. Hence, the minimum manning of one and a half Crews if there was a call-out. A Group/Sector Control Crew typically comprised the following volunteers:

Group Control	**Sector Control**
One Crew Officer	Two Crew Officers
Three Chief Observers	Four Chief Observers
Five Leading Observers	Six Leading Observers
20+ Observers	30+ Observers
Operational total c. 50 – 70	Operational total c. 70 – 90

I recently found my nominal roll showing the manning for Crew 3 at Bedford; this was a total of 30 in September 1991. For operations, as well as the members from Crew 1 and 2 we would have also had the two full-time officers, plus the ROC Group Commandant who was part-time and the UKWMO Warning Team.

The Warning Team (also volunteers) carried out the scientific role of predicting fallout, the path of fallout, and issuing warning instructions. Most of them had BSc degrees or other scientific skills; they were highly skilled and also did regular training. There was a Chief Warning Officer and an Assistant Chief Warning Officer who reported to the Group Controller.

Another recent view of 28 Group Dundee looking towards the triangulation alcove and the special table. This also gives the evidence that we also functioned as a Post. On the right wall of the triangulation alcove you will also see the BPI (Bomb Power Indicator). The left-hand Post Display Plotting Board shows '99' Post at the top left. The space down to the lower level has been covered by flooring which was carried out at some Sector Controls. Photo Colin Johnson

During exercises it was really the Group Controller who was the key decision maker. We may have also had a BT engineer and a plant engineer with us when we were operational but this could never be guaranteed. As a result some Crew members were trained in plant operation and maintenance. In our Crew 3, our aforementioned 'Paul the plumber' was one of these.

Sector Controls

Sector Controls had two Crew Officers plus additional ROC and Warning Officer personnel. They also had two Met Office Meteorological Officers. They would take the wind information from upper air stations and process this into a format called HOMET which would be used by the Warning Teams in each of their Group Controls.

The Sector buildings were extended underground at the middle (main) level from the original Group Control building design and had additional display boards and working areas. In Lincoln the new extension for the Sector went outwards through the original wall at the end of the original Canteen area. The building work was started in 1970 and completed in 1972 with Sector operation starting shortly after completion of the new room. The new extended area could also be reached from the lower level via a set of stairs breaking through from the data centre into the new extended area; this conversion was the standard plan.

These building conversions caused problems – at No 12 Group Bristol the building was not standard and the UKWMO Sector scientific staff were initially in a separate room with the ROC Crews communicating via a hatch in the wall. This became known in Bristol as the 'Berlin Wall'. The door near the hatch was then removed and the UKWMO Warning Team and the ROC now had much improved working conditions and all was well again.

Chas Parker who served at our No15 Group Sector Control in Lincoln (Fiskerton) has advised me that when they punched a hole into the new Sector section at Lincoln they damaged the waterproof membrane of the building. He says that to this day the building has never been waterproof and the current owners have a pump running 24 hours.

Modification to extend Lincoln into a Sector Control The side of the recently exposed bunker is seen on the right. Photo Chas Parker

The extra Sector roles included contact with our continental customers. One UKWMO Officer had the sole role as Continental Liaison Officer at a Sector. Clearly any of our fallout could reach them and any continental nuclear bursts may have also changed our own fallout patterns. Sectors exchanged information with our fellow NATO countries and 12 Group Bristol were also in contact with the Channel Islands.

France was a small problem (no comments please) as they were not a member of NATO after they quit in 1966. As a result special liaison methods were used to exchange information. We obviously wanted to know about their nuclear bursts and fallout; fallout to or from France would not have known that there was a boundary! I never worked at Sector level so more details of working methods will have to await another author.

Flood control

Only one Sector Control now remains fitted out – this is the Craigiebarns building at Dundee. With the support of 28 Group ROCA members this has been restored by

Gavin Saxby and his hard-working team. It was due to open its doors this year to visitors but sadly they had a flood which has set back all their plans. Sub Brit was one of a number of donors who helped support emergency intervention but other help or funding would be most welcome. If you would like more information or would like to help them, see: www.28group.org.uk.

After 1991 the ROC had a stand-down when most of the Observers were made redundant overnight. All the ROC Posts and Group/Sector Controls closed. Many of the Controls were empty for a long time before being demolished, however some have now been reused. As shown in the following table most of the other Control buildings have been demolished. The ones still in use at the 1991 ROC stand-down are highlighted in red:

No 1 Group:

Name: Maidstone

Type: Semi-sunken

OS Grid Reference: TQ750561

Address/Location: Ashmore House, 57 London Road, Maidstone, Kent

Opened: 25.6.1960

Closed: 1992

Current state: Extant

Current use (if extant): Located behind a Solicitors office and used for storage.

Notes: The Maidstone group was originally formed in 1925 as No 1 Group with its operations centre in the Corn Exchange Buildings. In 1929 it was relocated to the ground floor and basement of a house called 'Fairlawns' in London Road, Maidstone. In 1953, 1 Group merged with 19 Group (Beckenham) and the ROC centre moved to Beckenham which became 1 Group. Maidstone was retained as a secondary training centre. In 1959 the situation was reversed with Control moving back to Maidstone with the premises at Beckenham, at another house called 'Dura Den', retained as a secondary training centre until 1968. Control remained in the basement at 'Fairlawns' until the protected accommodation in the rear garden opened in 1960. 'Fairlawns' was retained for administration. In 1976 'Fairlawns' was renamed 'Ashmore House' in memory of the Corps' founder Major Ashmore. On closure, Ashmore House and the bunker were sold to a local firm of solicitors – Brachers. They used the house as their office and the bunker for storing old files. During the 1990s numerous ROC items including maps and signs were sold to the Kelvedon Hatch Cold War museum.

The bunker is no longer used for storage but remains in good condition. Occasional tours are organised by Maidstone Museum. The interior has been largely gutted apart from the plant room and the generator. The bunker was used by BBC 1 for a feature about the Cold War and the ROC in the 'One Show'.

The new control room at 1 Group shortly after opening in 1960

No 2 Group (Sector Control):

Name: Horsham

Type: Surface

OS Grid Reference: TQ174303

Address/Location: TA Drill Hall, Denne Road, Horsham, Sussex

Opened: 4.1962

Closed: 1992

Current state: Demolished (11.2004)

Current use (if extant): N/A

Notes: The Horsham group was originally formed in 1925 as No 2 Group at 'The Lindens' at 11 North Street, Horsham with the operations centre at the TA Rifle Range. In 1929 2 Group was relocated to the TA Drill Hall in Denne Road. The Centre remained there until protected accommodation open to the rear of the drill hall in 1962.

In 1972 the Control was colocated with the UKWMO Metropolitan Sector Control which moved there from RAF Uxbridge, to accommodate this a new larger control room was built on the west side of the blockhouse and a new brick-built administration block was added in the 1990s with the emergency exit from the bunker coming out inside the administration building.

The TA centre itself closed in 1999 and the site was sold to the local council for redevelopment. The main TA building was retained for community use and is available for hire, but the rest of the site was cleared for a new housing development known as Dukes Square.

The Sector room at 2 Group in October 2000. This room was added on the west side of the building in 1972. Photo Nick Catford

No 3 Group:
Name: Oxford
Type: Semi-sunken
OS Grid Reference: SP551051
Address/Location: James Wolf Road, Hollow Way, Cowley, Oxford
Opened: 15.5.1965
Closed: 1992
Current state: Extant
Current use (if extant): Storage
Notes: The Oxford group was originally formed in 1935 as No 4 Group at Post Office in Oxford. It was relocated to the New Bodleian Library in 1941 and relocated again to the Drill Hall, North Way Oxford in 1947. There was a third move in 1949 to Woodstock Road, Wolvercote. It was redesignated as No 3 Group in 1953. When protected accommodation was required this necessitated a fifth and final move to Cowley Barracks in 1965. A purpose-built accommodation block was provided alongside the bunker. In 1980 a Victorian barrack block was converted in for use as the headquarters of the UKWMO and was headed by a Director and Deputy Director supported by a small administrative staff.

The area was cleared in 1998 and a student accommodation block for Oxford Brooks University has been built on the site. The bunker however is still largely intact, only the surface entrance level consisting of the decontamination area has been removed; the lower floors now lie beneath a grassed courtyard between two student accommodation blocks. The bunker is owned by the Student Union. A lot of money has been spent on renovating it but initial plans to use it as a discotheque came to nothing – if it were to have a licensed bar the emergency exits would not be adequate. The bunker is currently used for storage.

3 Group control room seen from the balcony in 1982. Photo from *Oxford Mail*

No 4 Group:
Name: Colchester
Type: Surface
OS Grid Reference: TL985249
Address/Location: Errington Lodge, 22 Lexden Road, Colchester, Essex
Opened: 4.3.1961
Closed: 1992
Current state: Demolished (1995)
Current use (if extant): N/A
Notes: The Colchester group was originally formed in 1926 as No 18 Group with an Operations Centre on the top floor of the Post Office in the High Street. It was relocated to the Corn Exchange in the High Street in 1927 and relocated again to the GPO telephone exchange in 1931. Its final move was in 1943 when it was relocated to a Victorian house called 'Errington Lodge' on the outskirts of the town. The group was redesignated as 4 Group in 1953. Protected accommodation was provided at the rear of the house in 1961 with administration remaining in the house. 'Errington Lodge' is extant but the bunker was demolished in 1995 and the site is now occupied by housing.

The only photo of 4 Group control is this demolition view from 1995. Photo Nigel Smith

No 5 Group:
Name: Watford
Type: Semi-sunken
OS Grid Reference: TL985249
Address/Location: Cassiobury Drive, Watford, Herts
Opened: 18.11.1961
Closed: 1973
Current state: Extant
Current use (if extant): Storage
Notes: The Watford group was originally formed in 1931 as No 11 Group and was located in the GPO buildings in Market Street, Watford. In 1943 the ROC Centre was relocated to Cassiobury Drive, Watford where a purpose-built two-level brick Operations Centre with two single-storey prefabricated wings was built. The group was redesignated as 5 Group in 1953. Protected accommodation was provided at the rear of the existing building in 1961. The Group was disbanded during the 1968 reorganisation and its posts were dispersed to the Horsham, Bedford and Oxford Groups. The site was retained as a training centre attached to Metropolitan Area Headquarters, Uxbridge until 1973. It was put up for sale in 1974 and sold to the Park Veterinary Centre. They have converted the WWII buildings into their surgery, offices and reception area. The bunker is used for storage, mainly old records, discarded furniture and medical apparatus and cardboard boxes. The bunker remains in good condition with occasional formal visits allowed. The

WWII building is one of only two surviving buildings of its type, the other being at Knavesmire Road, York, where similar buildings are now used by the Hamilton Panthers Rugby Club as changing rooms.

5 Group control remains in good condition after 48 years of closure. It is seen here with its original white paint in April 2001. Photo Nick Catford

No 6 Group

Name: Norwich

Type: Semi-sunken

OS Grid Reference: TG23611

Address/Location: Chartwell Road, Norwich, Norfolk

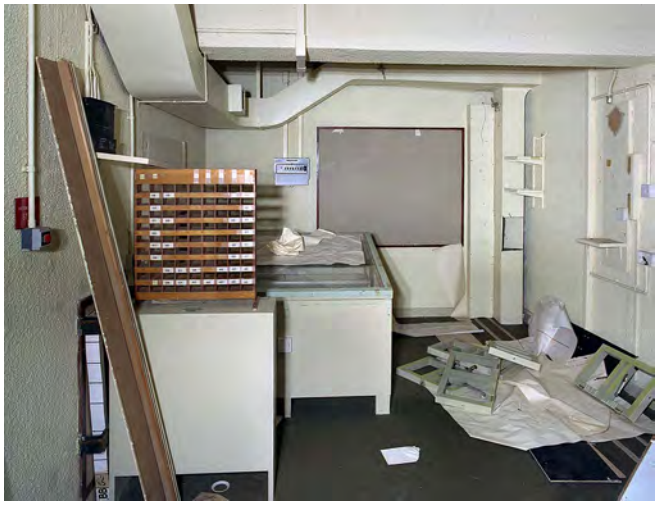
Opened: 27.9.1961

Closed: 1992

Current state: Demolished (2008)

Current use (if extant): N/A

Notes: The Norwich group was originally formed in 1934 as No 16 Group and was located in the basement of the GPO building in Dove Street, Norwich. In 1940 it was relocated to a new GPO building at St Andrews, Norwich. In 1940 it was relocated again to a house called 'Fairfield' in Lime Tree Road, Norwich, with St Andrews being retained for emergency use. It was used for a while in 1942 when the main cable at Fairfield was damaged by enemy action. There was final move in 1947 to RAF Old Catton in Chartwell Road. Protected accommodation was provided at the same site in 1961.



6 Group Triangulation alcove in March 2002

The site was sold to local property developer Belmont Industries in 1997. In 2001, Belmont received planning permission to build a Pizza Hut on the site but the backer pulled out. Despite a spirited local campaign to restore the bunker as a tourist attraction, Belmont demolished the bunker in July 2008. This put a halt to the campaign despite the fact that they had no planning permission at that time to develop the site. The site is still awaiting redevelopment.

No 7 Group:

Name: Bedford

Type: Semi-sunken

OS Grid Reference: TL028503

Address/Location: Days Lane, Biddenham, Bedfordshire

Opened: 1962

Closed: 1992

Current state: Demolished (1999)

Current use (if extant): N/A

Notes: The Bedford group was originally formed in 1935 as No 12 Group and was located in the Bedford telephone exchange. In 1943 it was relocated to Days Lane, Biddenham, where a two-level brick Operations Centre with two single-storey prefabricated wings was built. The group was redesignated as 7 Group in 1953.

My old No 7 Group Control at Bedford was demolished in 1999 and a small housing estate was built on the site. No 7 Group ROCA managed to convince the Council to name the new road Observer Close. We had the road opened with a formal ceremony and a parade of ex-Crew Observers. As the parade ended we had a flypast of a jet aircraft from Cranfield airfield organised by Joyce Shrubbs MBE, our ex-Midland Area Commandant.

7 Group Control Room seen from the balcony in October 1991. Photo Gary Crocker

Name: Coventry

Type: Semi-sunken

OS Grid Reference: SP457736

Address/Location: Lawford Heath, Rugby, Warwickshire

Opened: 2.11.1963

Closed: 1992

Current state: Extant – completely rebuilt internally and externally

Current use (if extant):

Notes: The Coventry group was originally formed in 1938 as No 5 Group and was located in the GPO building in Hertford Street, Coventry. In 1941 it was relocated to a house called 'Broadwater' in Earlsdon Avenue, Coventry, and was redesignated as No 8 Group in 1953. When protected accommodation was required this necessitated a third move to RAF Lawford Heath, a few miles from Rugby.

After the scrapping of the UKWMO (in about 1992), the Home Office considered using this bunker as a Regional Government Headquarters in place of the one at Drakelow, but in the event this never happened and the building was sold to a local business partnership. During the next few years it was only used for illegal raves and parties and quickly fell into disrepair. In 1997 the site was sold to the present owners Satellite Media Services who provide an international Internet service as well as providing the feed for IRN (Independent Radio News) and various local radio programmes. The old car park now houses large dishes and the underground area has been completely rebuilt and integrated into their control complex.

The 8 Group balcony has been given a 'facelift' during refurbishment of the building in December 2000. Photo Nick Catford

No 9 Group:

Name: Yeovil

Type: Semi-sunken

OS Grid Reference: ST551149

Address/Location: Southwoods, Hendford Hill, Yeovil, Somerset

Opened: 2.11.1963

Closed: 31.12.1993

Current state: Extant

Current use (if extant): Extensive house conversion

Notes: The Yeovil group was originally formed in 1938 as No 22 Group and was located in Princes Street, Yeovil. It was relocated to Southwoods in 1941 where a two-level brick Operations Centre with two single-storey prefabricated wings was built. The group was redesignated as 9 Group in 1953. When protected accommodation was required it was built into the side of a hill at the rear of the existing site. Administration was housed in the former 1941 prefabricated buildings although the WWII Operations Room was demolished when the new bunker was built.

After stand-down, Yeovil Group HQ was retained by the Home Office, acting as a nodal point for the Emergency Communications Network which was established there in July 1993 under the guise of G-CAT Computer Centre. This included the installation of a new SX2000 ECN unit, two computer terminals and a second standby generator. Sometime in the mid-1990s the site was offered for sale. After the council refused planning permission for four houses on the plot, the sale was abandoned and the centre remained in use until the spring of 2001.

After standing empty for eight years the site was eventually sold to a property developer who stripped all the earth cover from the top and front of the bunker and refurbished it as a luxury residence. Last quoted by the *Daily Mail* to be worth £700,000.

Only two Group Controls have been converted into houses, 30 Group at Oban and 9 Group. Here the earth cover has been removed from the front and side to allow windows to be fitted.

No 10 Group:

Name: Exeter

Type: Surface

OS Grid Reference: SX972960

Address/Location: Poltimore Park, Exeter, Devon

Opened: 1961

Closed: 1992

Current state: Extant

Current use (if extant): Now a 'post apocalyptic' Laser Tag game venue.

Notes: The Exeter group was originally formed in 1940 as No 21 Group and was located above the GPO in High Street, Exeter. The ROC Centre was relocated to a house called 'Barnfield' at Southernhay East, Exeter in 1942. In 1947 it was relocated to the GCI radar station RAF Exminster for a few months before moving to the former WWII RAF Sector Ops Room at Poltimore Park. The Group was redesignated as 10 Group in 1953.

When protected accommodation was required it was built alongside the old Sector Ops building which was retained for administration.

When the site was sold in 1999, East Devon Council were adamant that they would not allow any change of use stating that the building could only be used as a museum or be demolished. As a result it remained empty for many years and was badly vandalised and damaged by fire in this period. The council eventually allowed a change of use and in October 2006 both buildings were refurbished as a paintball venue as part of the UCZ Paintball chain.

10 Group Control Room in November 1999.
Photo Nick Catford

No 11 Group:
Name: Truro
Type: Surface
OS Grid Reference: SW821445
Address/Location: Albert Place, Daniel Street, Truro, Cornwall
Opened: 4.5.1963
Closed: 31.3.1973
Current state: Demolished (2003)
Current use (if extant): N/A

Notes: The Truro group was originally formed in 1940 as No 20 Group and was located in the GPO telephone exchange in Truro, moving to the Masonic Hall in Union Place in 1942. In 1949 the Masons wanted their building back so the Group was relocated to Fairmantle Street Primary School and the Group was redesignated as 11 Group in 1953. During WWII the school had been requisitioned for military use. Although the school had returned by this date an unused room on the upper floor with its own side entrance was found for the ROC. With the need for protected accommodation, there was a final relocation to Daniel Place, Truro in 1962. The new control was in use from December 1962 although not officially opened till the following May. The Group was disbanded in 1973 and its posts absorbed by 10 Group (Exeter)

The premises lay unused for two years until 1 June 1975 when the Control Room was reopened for a special duties team within No 10 Group. At general stand-down on 30 September 1991, the special duties team were transferred to the RAF and continued uninterrupted until total stand-down on 31 December 1995, making it the last ROC Group Control to close.

From that date, the building was retained under care and maintenance of the RAF at St Mawgan and the administration block was leased to the Truro Driving Test Centre. They moved out at the end of 2001 and the site was offered for sale. The bunker was demolished in 2003; the demolition company estimated that it would take three weeks. Ex Obs. Lt Lawrence Holmes had previously warned them about the thickness of concrete and the asbestos content. Six weeks later they were still working at the site. The original plan was for a supermarket on the site but instead seven houses were built – the approach road was named Observer Close.

11 Group Control in February 2002. Photo Nick Catford

The demolition of 11 Group Control in April 2003 took over six weeks. Photo Lawrence Holmes

No 12 Group (Sector Control):
Name: Bristol
Type: Former Army Anti-Aircraft Operations Room
OS Grid Reference: ST716702
Address/Location: Lansdown, Bath, Somerset

Opened: 22.8.1959
Closed: 1992
Current state: Extant
Current use (if extant): Training Centre and conference centre for Avon Fire and Rescue Service. The old above-ground Administration building is also for communications.

Notes: The Bristol group was originally formed in 1937 as No 23 Group and was located at the rear of the Library in Little King Street, Bristol. The Centre was relocated to Worcester Terrace in 1943 and again to Kings Square Avenue in 1947. In 1953 the Group was redesignated as 12 Group.

With the need for protected accommodation, there was a further move in 1958 to Lansdown on the outskirts of Bath to the recently vacated Royal Artillery anti-aircraft operations room for the Bristol Gun Defended Area (2 Group, 14 Brigade). The former operations room was given a major refit to accommodate the ROC. By 1972 the Control was colocated with the UKWMO Southern Sector Control.

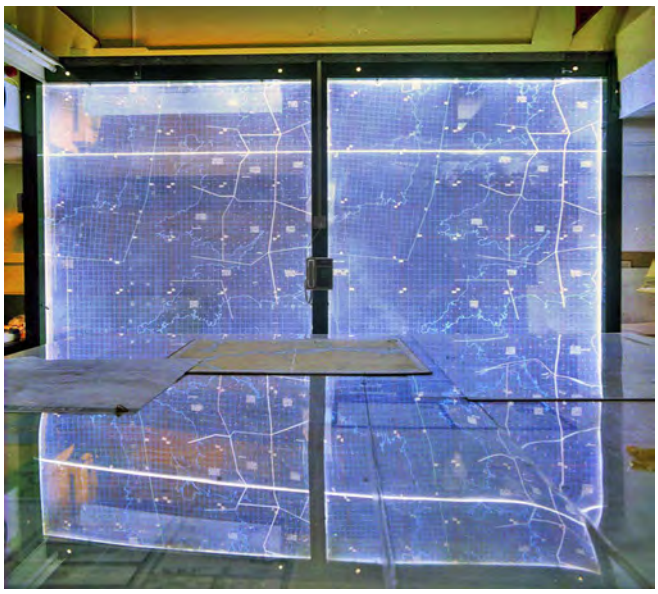
After the departure of the ROC, the site was taken over by the Avon Fire and Rescue Service and it is now their South West Command Development Centre. This is a high-tech centre for training and incident simulation and can also be used as a conference centre.

No 12 Group Control was located in a redundant Royal Artillery anti-aircraft operations room. The building is seen in September 1999 having been acquired by the Avon Fire and Rescue Service

No 13 Group:
Name: South Wales
Type: Surface
OS Grid Reference: SN405198
Address/Location: Picton Terrace, Carmarthen
Opened: 12.1961
Closed: 1992
Current state: Demolished
Current use (if extant): N/A

Notes: The Carmarthen group was originally formed in 1940 as No 28.1 Group and was located in the basement of the Lyric cinema in King Street. It was relocated to the TA centre in Picton Terrace in 1949 and redesignated as No 13 Group in 1953. A two storey brick admin block was later built to coincide with the opening of the protected accommodation in 1961.

After the ROC stand-down in 1991 the building was leased to the Carmarthen Civil Protection unit who maintained the bunker in superb condition with most of the ROC fixtures and fittings remaining in place. Their lease ran out at the end of March 2000 and the building was handed back to the Home Office for disposal. The admin block is still standing at the rear of the TA centre but a new building now stands on the site of the bunker.



In March 2000, nine years after closure, little has changed at 13 Group, even the A & B displays still light up.
Photo Nick Catford

No 14 Group:
Name: Winchester
Type: Surface
OS Grid Reference: SU494310
Address/Location: Abbotts Road, Winchester, Hants
Opened: 3.6.1961
Closed: 1992
Current state: Demolished
Current use (if extant): N/A

Notes: The Winchester group was originally formed in 1926 as No 3 Group and was located at the Blue Triangle Club in Parchment Street, moving to the telephone exchange in Brook Street in 1929. The Centre was relocated to Northgate House in Jewry Street in 1940, moving again to Abbotts Road in 1943 where a two-level brick Control Centre with two single-storey prefabricated wings was built. The group was redesignated as 14 Group in 1953. When protected accommodation was required this was built alongside, with the old Control Centre being retained for administration.

The Royal Observer Corps Museum was founded in June 1974 by a group of officers at the Winchester ROC Headquarters; it was housed in the redundant 1943 two-level Control Room. The Museum was developed with the aid of grants by Hampshire County Council and opened to the public on 24 October 1987. The building

closed in March 1992 following the stand-down of the ROC and the bulk of the collection was moved out at short notice. Unfortunately some of the exhibits were left there to be damaged or stolen by later intruders.

After closure in 1992, it had been hoped that the centre would permanently house an ROC museum and the local council put in a bid for the site. Unfortunately due to a bureaucratic blunder the site was sold to a lower bidder in 1993; he had plans to turn the 1943 building into a vet's surgery. The building was Grade II listed by English Heritage in February 1993 as the best remaining example of ten originally built. The redevelopment plans fell through and the owners decided to develop the whole site for housing but were frustrated by the Grade II listing which they were hoping to reverse. The veterinary practice owner was very helpful to Nick Catford when he made a visit. He was asked to call at the practice to collect the keys. The 'keys' consisted of a claw hammer, a crow bar and some nails to 'lock' the door again!

The site was eventually sold to Bay View Developments who applied to the council to demolish the bunker in 2004. Although English Heritage raised no objections to its being demolished, the council rejected the application in 2006. The bunker was however later demolished to avoid its being listed at some time in the future – this left only the listed 1943 building standing. A further planning application was submitted by Bay View in 2007 for the building of fourteen houses and the demolition of the listed building. However, it was clear from extensive technical investigations involving both the council and English Heritage that there were no viable alternative uses for it and demolition was approved. A housing development called Twiss Square now occupies the site.

Through the generosity of Hampshire County Council, the collection is now housed near Winchester in leased premises and is not available for public viewing. It mainly includes an archive of photographs, documents and personnel records covering the history of the ROC from its formation in 1925 until the final stand-down in 1995.

14 Group Control in March 1996. The admin block which housed the WWII ROC Centre is seen on the left. One corner of the two level ops room can just be seen. Photo Nick Catford

No 15 Group (Sector Control):
Name: Lincoln
Type: Semi-sunken
OS Grid Reference: TF046725
Address/Location: Fiskerton, Lincoln
Opened: 10.12.1960
Closed: 1992
Current state: Extant
Current use (if extant): Police training facility

Notes: The Lincoln group was originally formed in 1936 as No 11 Group and was located in the Lincoln telephone exchange. It was relocated to St Peters-at-Arches church in 1938, moving again to Norwich Union Insurance Company offices at St Martins Hall, Lincoln in 1943 and then to RAF Waddington in 1947. The Group was redesignated as 15 Group in 1953 when it was merged with the former No 6 Group in Derby. When protected accommodation was required, this involved another relocation to RAF Fiskerton with Waddington being retained as a secondary training centre.

In 1972 the centre was colocated with the UKWMO Midlands Sector Control and the bunker was partially rebuilt with a new control room on the lower floor. Contractors did much of this work without interrupting the operation of the Control Centre. They eventually punched two doorways through the wall, one from the balcony and the other from the rest room. The original two-level control room was floored over in 1989/1990.

In 1998 the site was sold to Primetake, a company making specialist ammunition, much of it supplied to the police, who later equipped the bunker as a rapid intervention skills police training facility which is still in use today. Visitors are not welcome.

15 Group plotters in 1975. Photo Ian Stafford

No 16 Group:
Name: Shrewsbury
Type: Surface
OS Grid Reference: SJ499126
Address/Location: Holywell Street, Shrewsbury
Opened: 13.1.1962
Closed: 1992

Current state: Extant
Current use (if extant): Veterinary practice

Notes: The Shrewsbury Group was originally formed in 1938 as No 29 Group and was located in the cellar of Shire Hall, relocating to London Road, Shrewsbury, in 1943. When protected accommodation was needed, this involved another relocation to Holywell Road in 1962.

The Abbey Veterinary Centre now uses the front part of the Control Centre and windows have been installed. An office block called 'Observer House' has been built at the rear. The building has been split into two, with walls built across the main corridor beyond the officers' room – access from the control room to the BT equipment room has been blocked. The balcony has also been floored over. All the plant has been stripped out, as well as the original toilets. There is a cabinet in the vet's waiting room containing ROC memorabilia including photographs, badges, ROC crest, radiation detectors and so on.

16 Group Control is now a veterinary centre

No 17 Group:
Name: North Wales
Type: Surface
OS Grid Reference: SJ358528
Address/Location: Borras, Wrexham, Clwyd
Opened: 1962
Closed: 1992
Current state: Extant
Current use (if extant): Recording studio

Notes: The Wrexham group was originally formed in 1936 as No 26 Group and was located in the town's telephone exchange. The Centre was relocated to 1 Acacia Pavril in 1942 and again to Tenters Square, Wrexham in 1947. Wrexham Control closed at reorganisation in 1953 when it merged with Caernarvon Group. When protected accommodation was required, the Group was reformed as No 17 Group in 1962 with a new location at Borras.

In 1996 the Control Centre was bought by a company called K-Klass who established a recording studio there and produced numerous UK and worldwide chart hits. Early in 2006 the 'Bunker Studios' were acquired by 'Audioideas', a company owned by Chester-based music producer David O'Connor who spent £140,000 rebuilding the studio to accommodate live bands.

The Control Room at 17 Group is now a recording studio, seen here in March 2001. Photo Nick Catford

No 18 Group:
Name: Leeds
Type: Semi-sunken
OS Grid Reference: SJ358528
Address/Location: Harrogate Road, Yeadon, Leeds
Opened: 11.4.1964
Closed: October 1968
Current state: Extant
Current use (if extant): Located in a secure private compound**.**

Notes: The Leeds group was originally formed in 1938 as No 8 Group and was located in Vicar Lane, Leeds, moving to the GPO building (presumably the telephone exchange) in 1939. The Centre was relocated to Grove House in Grosvenor Road in 1942. The group was redesignated as No 18 Group in 1953, absorbing part of the territory of former No 10 Group, York. When protected accommodation was required, a new location on the west side of Harrogate Road, Yeadon, was selected.

The 19 Group Control still retains its original white paint; seen here in May 2000

The Group was disbanded in 1968, the greater part being transferred back to 20 Group, York with remainder going to 15 Group, Lincoln. After closure, the bunker was taken over by the Royal Naval Reserve who used it as a training centre. They vacated it around 1995 and the bunker was incorporated into the adjacent industrial estate and is currently available for rent. The bunker is surrounded by secure car storage.

No 20 Group:

Name: York

Type: Semi-sunken

OS Grid Reference: SE580515

Address/Location: Acomb Road, York

Opened: 16.12.1961

Closed: 1992

Current state: Extant

Current use (if extant): Museum/EH Tourist attraction.

Notes: The York group was originally formed in 1937 as No 10 Group covering the North Riding of Yorkshire and No 11 Group covering the East Riding of Yorkshire and North Lincolnshire. The ROC Centre was at the GPO at Lendall and consisted of a large wooden hut at the rear of the exchange with a central corridor serving two operations rooms. In 1943 the Centre was relocated to common land at Kavesmire, York where two two-level brick Operations Centres with single-storey prefabricated wings were built 100 yards apart. At reorganisation in 1953 the northern part of No 10 Group, attached to that of No 9 Group, was redesignated as No 20 Group – the remaining southern part was attached to No 18 Group, Leeds.

When protected accommodation was required the Group moved to 'Shelley House' at Acomb. The administration offices were in the house with the bunker located to the rear.

20 Group Control in May 2000, before English Heritage began restoration. Photo Nick Catford

In the 1990s the site was bought by English Heritage who used Shelley House as its York Office. The future of the bunker was secured in 2000 when it was granted Scheduled Ancient Monument status. Shelley House was sold for redevelopment but English Heritage retained the bunker which was fully restored and opened to the public as a tourist attraction in 2006. It now receives around 5,000 visitors each year even with its limited opening days.

No 21 Group:

Name: Preston (Sector Control)

Type: Former WWII RAF Group Control operations room and postwar ROTOR Sector Operations Centre

OS Grid Reference: SD539364

Address/Location: Langley Lane, Goosnargh, Lancs

Opened: 1.1961

Closed: 1992

Current state: Extant

Current use (if extant): Data centre

Notes: The Preston group was originally formed on 1 January 1962 as No 21 Group covering territories formerly administered by the abolished Lancaster and Manchester Groups. The Group Centre was located in the former Fighter Control operations block with Lancaster (closed 1967) and Manchester (closed 1970) being retained as secondary training centres. By 1972 the Centre was colocated with the UKWMO Western Sector Control.

After closure in 1992, the Control found a new short-term use when, after an extensive refit, it was converted to become RGHQ 10.1 as part of the national RGHQ network. However, within a few months all the RGHQs closed. The site was sold in 1994 to the Oakhill Veterinary Centre. They established their business in the ROC administration buildings but after ten years realised they had little use for the bunker and it was put on the market. The bunker was sold in 2005 and now houses a specialist data centre. Visitors are discouraged, although the new owner has an interest in the ROC. See 'The Post that moved twice' in the next issue of Subteranea.

21 Group Sector Room in July 1991. Photo by Terry Tracey

No 22 Group:

Name: Carlisle

Type: Surface

OS Grid Reference: NY383605

Address/Location: Grindlesdyke, close to the former RAF Carlisle, Cumbria

Opened: 1962

Closed: 1992
Current state: Demolished (1996)
Current use (if extant): This location is now used as the HQ for 1862 Sqn. Air Training Corps. The original aerial tower is understood to remain for ATC use.

Notes: The Carlisle group was originally formed in 1939 as No 32 Group and was located in Huntingdon Funeral Company's underground stables at West Walls, Carlisle. In 1941 the Centre was relocated to 10 Norfolk Road, Carlisle. As part of the 1943 reorganisation the Group was redesignated as No 22 Group, but in March 1954 the Group was disbanded with its posts dispersed to Ayr, Lancaster and Durham Groups.

Following the closure of the Lancaster Group, Carlisle was reformed as No 22 Group in January 1962 and was located at No 14 Maintenance Unit, RAF Carlisle.

22 Group Control at stand-down in 1991. Photo David Snow

No 23 Group:
Name: Durham
Type: Surface
OS Grid Reference: NZ276429
Address/Location: The Sands, Durham
Opened: 6. 1961
Closed: 1992
Current state: Demolished (mid-1990s)
Current use (if extant): The site is now a car park

Notes: The Durham group was originally formed in 1937 as No 30 Group and was located in the telephone exchange in Providence Row, Durham. It was relocated to The Sands in 1951. As part of the 1953 reorganisation, Durham was redesignated as No 23 Group with some of the posts from the disbanded Galashiels Group being absorbed.

The protected control centre was opened on the same site in 1961. The Durham Control was unique being a standard surface blockhouse with the administration offices on the roof. These were accessed from the top of the stairs up to the control room balcony.

23 Group Control, note the admin block built on the roof. Photo Terry Armatage

No 24 Group:
Name: Edinburgh
Type: Semi-sunken
OS Grid Reference: NT159739
Address/Location: Alongside the entrance to RAF Turnhouse, Edinburgh
Opened: 10.1964
Closed: 1992
Current state: Demolished
Current use (if extant): N/A

Notes: The Edinburgh group was originally formed in 1947 with the transfer of 31 Group Control from its former location at Galashiels. It was located at 14 Carlton Terrace in Edinburgh. The Group was redesignated No 24 Group in 1953 and when protected accommodation was required it was relocated to RAF Turnhouse in 1962.

24 Group Control in 1995, four years after closure. Photo Chas Parker

No 25 Group:
Name: Ayr
Type: Surface
OS Grid Reference: NS347244
Address/Location: 17 Waterloo Road, Prestwick, Ayr
Opened: 1962
Closed: 1992
Current state: Demolished (2000)
Current use (if extant): N/A

Notes: The Ayr group was originally formed in 1940 as No 33 Group and was located in Nile Court Ayr. The Centre was relocated to the Masonic Hall, Ayr in 1943, moving back to Nile Court in 1947 and moving again to Bellrock Avenue, Prestwick in 1951. In the 1953 reorganisation the Group was redesignated as No 25

Group. When protected accommodation was required there was a final relocation to Monkswell House, 17 Waterloo Road, Prestwick.

After closure the site was bought by the Kingcasse Parish Church who wanted to use the land to expand their car park. Some items, including the tables from the control room, were taken out shortly after the Church acquired the site and are now on display at the Anstruther museum. The bunker was demolished shortly after the Sub Brit visit in 2000. There is now a block of flats on the site with the access road called Observer Close in our memory.

25 Group Control in February 2000, shortly before the building was demolished. Photo Nick Catford

No 27 Group:
Name: Oban
Type: Surface
OS Grid Reference: NS347244
Address/Location: At the southern end of North Connel airfield at the stub end of the old road alignment alongside the airfield.
Opened: 26.5.1962
Closed: 1973
Current state: Extant
Current use (if extant): House conversion

Notes: The Oban Group was formed in 1940 as No 35 Group and was located in the Oban telephone exchange in Drimvargie Terrace. It was relocated to Nissen huts in Albany Street in 1947. During the 1953 reorganisation, the Group was redesignated as No 27 Group. When protected accommodation was required the Group was relocated to RAF North Connel.

In 1973 the Group was disbanded and all posts were transferred to No 30 Group although Oban Control was retained as a stand-by communications centre and NRC for Inverness Group HQ until 1992. It remained in care and maintenance until 1997 and was then reactivated as a helicopter training centre attached to RAF Kinloss. It has trained crews for Kosovo. It was also available as a general training centre for other services including Police, Fire Brigade etc. In 2013 the bunker and adjacent admin building were undergoing conversion into a private residence.

27 Group Control in February 1987. Note the AWDREY instrument on the roof. Photo Alan Bradshaw

No. 28 Group:
Name: Dundee (Sector Control)
Type: Semi-sunken
OS Grid Reference: NO439314
Address/Location: Craigiebarns Road, Dundee
Opened: 29.4.1961
Closed: 1992
Current state: Extant
Current use (if extant): Being restored to original condition

Notes: The Dundee group was originally formed in 1939 as No 37 Group and was located at St Cuthbert's Hall, Dundee. It was relocated to Craigiebarns House in Craigiebarns Road in 1943. At reorganisation in 1953 the Group was redesignated 28 Group.

When protected accommodation was required, this was located in the back garden of Craigiebarns House which remained in use for administration. In 1973 the centre was colocated with the UKWMO Caledonian Sector Control; to accommodate this, the bunker was partially rebuilt with a new control room on the lower floor. Caledonian Sector Control had previously been located since 1964 in the former Chain Home Radar transmitter block at School Hill in Aberdeenshire.

28 Group Sector Room during Intex 91,
(NATO International Warning and Detection Exercise).
Photo by J A Tallett

The contractor who renovated the house donated the bunker to the Civil Defence and Emergency Service Preservation Trust. It is now entered through a small housing estate to the left of the house through a sham house built by the contractors to disguise the bunker entrance. The house is in fact brick and pebbledash cladding around the original surface blockhouse with a tiled roof resembling those on the surrounding estate.

The bunker is managed by Sub Brit member Gavin Saxby who with a team of volunteers is restoring the bunker to its original condition. Wherever possible, original or identical ROC equipment and furniture is being reinstalled in the refurbished bunker. Visits for interested groups can be arranged. See Craigiebarns Facebook page https://www.facebook.com/28Group/

No 29 Group:
Name: Aberdeen
Type: Surface
OS Grid Reference: NJ905084
Address/Location: Quarry Road, Northfield, Aberdeen
Opened: 15.5.1961
Closed: 1992
Current state: Demolished
Current use (if extant): N/A

Notes: The Aberdeen group was originally formed in 1939 as No 38 Group and was located in the Old Infirmary Building in Woolmanhill, Aberdeen. As part of the 1953 reorganisation the Group was redesignated 29 Group. When protected accommodation was required, a new location at Quarry Road, Northfield was selected. It comprised a surface blockhouse with a single-storey admin block. John Mackay MP formally opened a two-storey training block alongside on 1 Sept 1986. As well as an outside door, an interior door allowed access into the bunker through the canteen wall.

29 Group Control. The two-storey training block opened in 1986 is seen on the right. Photo David Robertson

No 30 Group:
Name: Inverness
Type: ex-WWII RAF 13 Group Control Operations Room
OS Grid Reference: NH683455
Address/Location: King Duncan's Road, Inverness
Opened: 13.12.1961
Closed: 1992
Current state: Demolished
Current use (if extant): N/A

Notes: The Inverness group was originally formed in 1939 as No 39 Group and was located in an annexe of the Caledonian Hotel in Inverness. In 1945 the group relocated to the Operations room of the WWII 13 Group (RAF) Sector Operations Centre at Raigmore with a purpose-built brick admin block alongside. As part of the 1953 reorganisation the Group was redesignated 30 Group.

The bunker was refurbished in the early 1990s with a new ventilation system installed and all the asbestos removed. The work had started before stand-down and the PSA (government property agency) took the opinion that as the work had to be paid for the contractors might as well finish it. After the work was completed the site was sold to a developer and the bunker demolished. The site has now been redeveloped.

30 Group Control in July 1992. The Inverness control was located in the WWII 13 Group (RAF) Sector Operations Centre

No 31 Group:
Name: Belfast
Type: Former Army Anti-Aircraft Operations Room
OS Grid Reference: IJ263658
Address/Location: Army Headquarters Northern Ireland, Thiepval Barracks, Knox Road, Lisburn, Co. Antrim
Opened: 13.12.1963
Closed: 1992
Current state: Extant
Current use (if extant): Army communications centre.

Notes: The Belfast group was originally formed in 1953 as No 31 Group and was located at Houston Park, Orangefield, Castlereagh. When there was a requirement for protected accommodation, the Group was relocated to Army Headquarters Northern Ireland where the recently vacated Royal Artillery postwar anti-aircraft operations

31 Group Control seen from the balcony during the last Intex in April 1991. Photo from 31 Group ROCA Heritage Team

room for the Belfast and Londonderry Gun Defended Area (3 Group, 51, Brigade) was available for use. The former operations room was given a major refit to accommodate the ROC. A prefabricated admin block was also built alongside. After stand-down an Army communications centre was installed in the two-level control room. On 14 October 2007 a plaque was unveiled on the building to commemorate the Northern Ireland 31 Group ROC HQ. The building was refitted in the late 2000s and the Army now uses it for computer servers.

Finale

I hope this article has given an insight of what happened inside the ROC Group and Sector Control buildings performing the triangulation and analysis of the hundreds of ROC Post reports. I hope you will be inspired to visit the Group Control bunker at Acomb in York. Craigiebarns Sector Control at Dundee in Scotland will also be a fascinating site – the only remaining Sector Control – when this opens to the public. If you need more information about the ROC in general, please visit our ROCA Heritage Team website: **www.roc-heritage.co.uk.**

My thanks go to Nick Catford, Edwina Holden MBE and Lawrence Holmes MBE for their help with both of my recent articles. Further thanks for this article go to Jenny Morris, Chas Parker, Simon Craine and other ROCA members who have given me 'snippets' of information. To quote the ROC Motto, *Forewarned is Forearmed*.

Subterranea Britannica

Notice of Annual General Meeting 2016

The AGM will be held on Saturday 23 April 2016, commencing at 10.00am at the Royal School of Mines, London, in association with the Spring Meeting

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Documents for the AGM will be available on our website at www.subbrit.org.uk at least 28 days in advance of the meeting. We will send an email via 'mySUBBRIT' to advise when the documents are available. Those members who have registered to receive documents by post will be sent them when they become available.

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Minutes of the AGM 2015 were printed in Issue 39 of *Subterranea*.

Spring Meeting 2016

Saturday 23 April, commencing at 10.25am,
Royal School of Mines, London, SW7 2BP

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There will be the usual mix of interesting illustrated talks along with Members' contributions and a chance to meet and mingle with fellow enthusiasts.

There is more detail on the Flyer enclosed in this journal, with details of how to book – either via the website at www.subbrit.org.uk/events or by post.

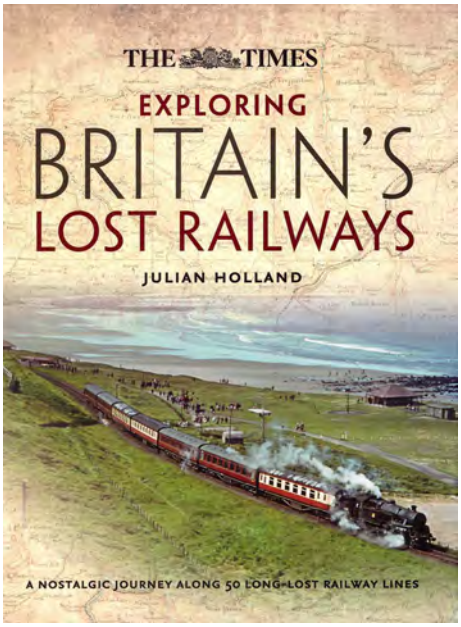
Cost £20 to include a sandwich lunch.

Please put the date in your 2016 diary now!

Britain's Lost Railways

Julian Allason

To connoisseurs of lost railways Julian Holland is The Man. No abandoned tunnel, overgrown cutting or rusting viaduct seems to have escaped his affectionate notice. Now, with the backing of *The Times* newspaper, Mr H has deployed his formidable knowledge for the benefit of a public wider than industrial archaeologists and trainspotters.



Recent publication of *Exploring Britain's Lost Railways* has served to reignite interest in the subject – and provide positive encouragement to get out and explore the miles of former track that have been converted into cycleways, footpaths and in some cases, heritage railways.

Subtitled 'A nostalgic journey along 50 long-lost railway lines', it provides an intriguing regional guide to routes that are both pleasurable to explore while furnishing atmospheric reminders of what was so wantonly destroyed. Walking some of these tracks, one is astonished to discover how much of the Victorian infrastructure survives from the age of steam: a tumbledown signal box here, a watering tower there, a converted station.

Tunnels to explore

Subterranean features are well represented in this landscape. Indeed it came as a surprise to the present writer how many former railway tunnels have been incorporated into local authority maintained paths in an era of health and safety and speculative litigation. Who knew that the long-closed St Leonards branch line in Edinburgh was now open to walkers and bicyclists, including the 556 yard long tunnel beneath Arthur's Seat?

The interest is not just technical – the bore is lined with sandstone – but historical, being Scotland's first railway tunnel, opened in 1831 when trains were rope-worked. Access is from St Leonards Lane goods yard (now a vegetarian restaurant), along the 1-in-30 gradient through the now well-lit and paved tunnel to emerge in the green and pleasant Holyrood Park.

The illustrations included in this handsomely designed volume have been intelligently deployed to illustrate both the lines in their heyday and what today's traveller will encounter, which is a surprising amount in the way of railway artefacts. Half-inch and one-inch-to-the-mile Ordnance Survey maps of the 1920s and the more detailed 1:25,000 projections of the 1930s to 1950s are used as the background, rendering the routes with clarity – truly a cartographic labour of love.

Also illustrated are curiosities like the 1924-vintage car-loading platform at Okehampton in Devon where car transporters were used for a short-lived service from Surbiton intended to appeal to long weekenders. It didn't and shortly closed, though the ramp survived long after.

The 1831 tunnel beneath Arthur's Seat, Edinburgh

The 150-yard long Swainsley Tunnel was built to hide the railway from the sensitive eyes of the owner of a nearby mansion. It is seen here two months after the line's closure on 10 March 1934. That same year the LMS gave the trackbed to Staffordshire County Council to use as a footpath. The tunnel is now shared by walkers and cyclists on the Manifold Way

Railways and mining

One cannot fail to be struck by how intricately connected were the railways and mining. Many of these lines were first conceived as solutions to the problem of transporting coal, ore or stone from mine to coastal port, and continued to serve this function long after passenger services were deemed uneconomic. Happily, preservation orders protect many of the features that would otherwise have been lost. Eccentricities like the West Somerset Mineral Railway have been reopened as footpaths; its chief feature, a three-quarter-mile inclined plane with a one-in-four gradient, is now scheduled as an ancient monument.

Built to transport iron ore mined in the Brendon Hills to Watchet Harbour, the line enjoyed a chequered history until sold lock, stock and winding gear at auction in 1924. The fit can now follow by mountain bike or on foot the route taken by passengers hauled in an open wagon, travelling at their own risk, derailment not being infrequent. The winding house survives, incidentally.

Of the 7,000 miles of track closed, some five hundred miles have now reopened as heritage railways, their reach slowly extending year by year, with a useful source of income being provided by location filming fees. Not all of the lines lost were attributable to the axe of Dr Beeching and his master, transport minister Ernest Marples. The process of commercial rationalisation of routes and amalgamation of railway companies had already served to prune uneconomic lines.

The combination of wartime damage to the network, post-nationalisation mismanagement and inadequate investment left the railways poorly equipped to compete with increased car ownership. Then there were natural disasters like the tidal surge that damaged the North Norfolk Railway between King's Lynn and Wells-next-the-Sea beyond affordable repair, a catastrophe that blighted local coastal resorts for two generations.

The ventilation shaft at Great Oxendon. Photo Andrew Farren

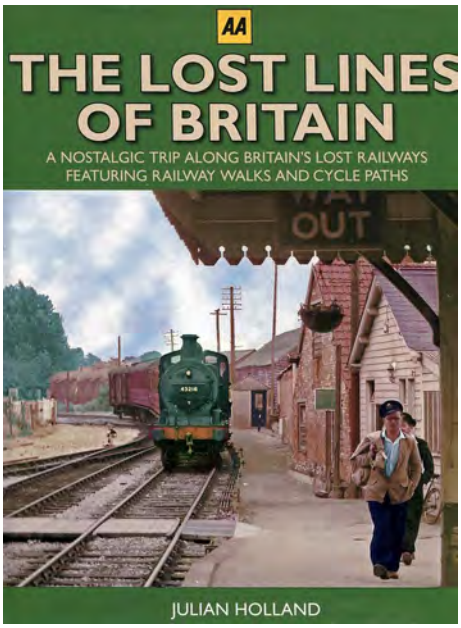
As one walks these abandoned routes there are stories embedded in what is left of the permanent way. An example is the unexpectedly large Shaugh Tunnel on the GWR between Plymouth and Tavistock, built as it turns out to accommodate Brunel's broad-gauge track. Today it forms part of the Drake Trail – though be sure to bring a torch with which to note detail.

One is also directed across spectacular viaducts and to places of rest like Rayne Station in Essex, now an agreeable café and visitor centre. Another well-maintained track is the Midshires Way between Market Harborough and Northampton that offers two interesting bores, the northernmost Kelmarsh Tunnel near Great Oxendon being served by a ventilation shaft that emerges into the sort of tower that rich landowners often had castellated to resemble follies. Such is the social history of Britain embedded in the saga of the abandoned railways.

My own formative recollection is of going to school on a steam-hauled service along the Three Bridges to East Grinstead line, disembarking at Grange Road. At Rowfant there was a mysterious site adjacent to the station, then still secret and guarded, that we now

know to be an RAF fuel depot. For the ten-year-old me it bonded an imaginative connection between steam railways and secret sites that has never quite been severed.

The line, which closed in 1967 despite Dr Beeching's residence nearby and consequent local unpopularity, reopened twelve years later as the Worth Way footpath and cycleway. It is one of many of these routes filmed by the redoubtable Chris Bedford of Dumpman Films.


AA
THE LOST LINES OF BRITAIN
A NOSTALGIC TRIP ALONG BRITAIN'S LOST RAILWAYS FEATURING RAILWAY WALKS AND CYCLE PATHS
OUT
JULIAN HOLLAND

Disused Stations on the internet

A valuable resource that is entirely compatible with this volume is the Disused Stations website curated with panache by Sub Brit's own authority on deceased railways, Nick Catford. Indeed before following any of the abandoned routes recommended, a consultation with this website will flesh out the history – often extraordinary – adding a fresh dimension to the expedition.

A final word of warning however: owners of Julian Holland's recent AA-sponsored *The Lost Lines of Britain* may detect some overlap in the subject matter if not the exact content. The latter book is £5 cheaper and slightly less well laid-out but no less enjoyable. If exploration of abandoned railways appeals, the pair constitute definitive coverage of the subject and an agreeable guide to exploration on foot or from the armchair. Leafing through the pages, one can almost hear the ghostly whistle of a steam train.

Exploring Britain's Lost Railways

by Julian Holland, Times Books, £30

The Lost Lines of Britain by Julian Holland, AA Books, £25.

www.disused-stations.org.uk

Dumpman Films: www.dumpman.co.uk

Contributions to Subterranea

We are always on the lookout for articles to include in the magazine. If you've been to an interesting site, have some good photos of one of your visits, or have done some research then how about writing a few lines and sending in some photos. We have a strong team of editors and proof-readers, so don't worry if you feel your writing is not up to scratch – we can usually polish it up a bit. It doesn't have to be a long article – a few paragraphs are always welcome for the news section or for tasty fillers. If you do feel you could write a longer article, then we have some guidelines for authors to help you – just ask us.

Please contact Nick Catford on nick@catford.orangehome.co.uk

Ideal Christmas present for a Sub Brit member?

This shop sign looks too good to be true – an opportunity to select your very own underground site. Sadly on closer inspection it turns out to be directions to the self-service fruit department. Ah well, a different sort of Plant Room!

Tracing the Story of the WWII Auxiliary Units in Northumberland

Ian Hall

Inside the main chamber of the Alnwick Zero Station. Photo Colin Anderson

I have been living in Northumberland for more than thirty years now, and although I am still not a true Northumbrian, I have found the place where I hope to be able to live out the rest of my days. For those with a historical bent, it is a fascinating part of England, and if your interests tend towards military matters, then there can be few better places to visit.

From Iron Age hill forts, through the Roman frontier, the Normans, the Border Wars with Scotland, the lawless days of the Border Reivers, and on to modern times – there is something for everyone. And the relative remoteness of the county has allowed much to survive that might have been lost in other parts of the country.

Relics of War

For me, however, it is 20th-century defences that are really my area of interest, and in particular, those from World War II. Northumberland, like most parts of the UK, has quite a wide range of relics from this period but, unlike some southern counties, it has been relatively neglected with regards to published material. It was this

The entrance to the Zero Station, with the escape exit indicated by the red arrow. Photo Colin Anderson

lack that prompted me, in 2013 (after a number of years of prevarication) to write and publish my first small book – *Relics of War* – which covers the modern military remains in the Northumberland landscape.

Of all these remains, the ones that most fascinated me were those of the Auxiliary Units (AUs). I had seen various documentaries on TV about them, but initially didn't expect to ever see an underground base myself.

It was during a random conversation regarding local pillboxes that someone told me about an underground bunker to the north of Alnwick. The directions were very vague and the search was fruitless to start with. But eventually, with a little thought about the relative age of the trees in the woodland, I found the older wood at the top of the hill and the two entrances to what turned out to be the local Zero Station. I was hooked on the Auxiliaries!

Following this, I was able to make contact with a number of local people who had already done a lot of research into the AUs, and over the next few years I was able to visit a number of the surviving Operational Bases (OBs).

Eventually, in conjunction with these local experts, I have just published another small book – *Most Secret* – specifically about the Auxiliary Units in Northumberland which is being reviewed elsewhere in this edition of *Subterranea*. (See page 19).

So before I start, my thanks must go to Stephen Lewins, who has done the most to fix the location of the remains of the county's Operational Bases; Phil Rowett, who has interviewed many of the old Auxiliaries (it is hoped that his work too will be published in the near future); and Bill Ricalton, who grew up during WWII and personally knew a number of the members of the local patrols in his area. Without these three, neither the book nor this article would be possible.

Anthony Quayle

The stories of Northumberland's AUs are remarkable, but equally, no more remarkable than those from all other parts of the country. The county did have one of the most famous Intelligence Officers in Anthony Quayle (1913–89), the future actor, film star and 'Sir'. Is it too fanciful to think that his portrayal of Major Franklin in *The Guns of Navarone* was perhaps a little influenced by his experiences in the hills of Northumberland?

Bill Ricalton recounts a story when, after he had finished a presentation about the AUs to a local WI group, an elderly lady approached him and said he had answered a question that had long puzzled her – why her father used to bring Anthony Quayle back for tea during the war! One small story that typifies the seriousness with which the Auxiliaries took their vow of silence – which has so hampered researchers.

But to go back to the start of the story in Northumberland, the area's first Intelligence Officer was Captain John "Hamish" Watt-Torrance. He came north, seeking suitable candidates for local leaders, and his first 'recruit' was Lambert Carmichael, a farmer from Scremerston near Berwick-upon-Tweed. From this start, the number of patrols quickly expanded, until there were twenty-one across the county, covering the rural areas in the north, as well as the mining areas in the south.

Elephant Bases

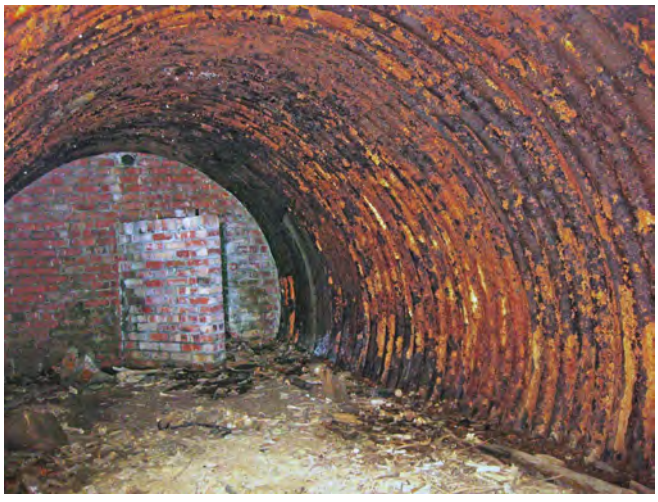
As with other parts of the country, the patrols initially organised their own bases – the Scremerston patrol reputedly had their first one hidden under a cold frame, and the Alnwick patrol used one of the Duke of Northumberland's farm buildings, but neither of these have been able to be confirmed on the ground.

Subsequently, the patrols were all provided with a standard 'elephant' type OB, built by the 184th Tunnelling Division of the Royal Engineers. This design of OB was a bit like a buried Nissen hut with the main shaft and emergency exit (with a bit of imagination) forming the trunk and tail of the elephant! Northumberland was one of the later areas to be provided with these bases, with the final ones not being completed until towards the end of 1942.

There is a list of all the RE Operational Bases in the county, together with the six-figure Cassini map references. But anyone who has tried searching for an OB will know how hard they are to find – which was of course the original intention. And time has only made the task more difficult. At best, the six-figure references are only accurate to 100 metres – and 100 metres square is quite a lot of woodland to search. In reality, the references are not always that accurate and some have their numbers accidentally transposed – so finding the bases is a process that can take a lot of time.

A few of course are reasonably well known locally, and were identified during the original Defence of Britain project. But the reality is that finding them has been a case of diligent field work, by Stephen Lewins, searching wide areas of overgrown land. And in the end, many of the bases have either collapsed completely or have been destroyed.

Of the twenty-one in Northumberland, the location of six remains unknown, two have been destroyed and seven have collapsed. Of the remaining six that are extant, only



The best preserved Operational Base. Photo Stephen Lewins

one is in what you might call "fair" condition. The rest are deteriorating quite quickly, with one in particular suffering badly a couple of years ago when a cow caused a major collapse. The cow was uninjured, but the same could not be said of the OB, the remains of which have now been fenced off which will hopefully prevent a recurrence.

Special Duties Section

If little is known about the Operational Patrols, then even less is known about the Special Duties section. This was a parallel network of civilian observers who operated a secret wireless network which included 'Out Stations'. These reported to a Control Station which itself had an associated underground 'Zero Station' (so called as transmissions would have included the code word 'zero' after their code name).

While a very few patrol members did eventually talk about their exploits, the Special Duties teams have taken their stories to the grave. The only local testimony that we have is from two of the ATS operators who worked in the Control Station.

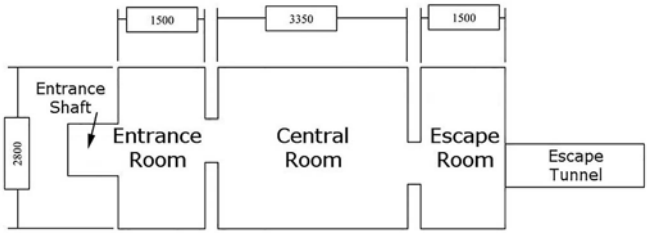
The location of only one Out Station is currently known, and that has now been lost when the building was refurbished. It was in a cupboard in Longhorsley Tower – a 16th-century defended tower house from the time of the Reivers. It is interesting to see how the layers of history often overlap!

The Out Station in Longhorsley Tower, before refurbishment. Photo Bill Ricalton

I need to quote Bill Ricalton again:

"One of my friends, Pat Webb, lived in the Tower with his parents. Pat was convinced that there was something hidden in their garage. We made several attempts, whenever the opportunity became available, to solve the perceived mystery – we found nothing. What had sown the seed of intrigue? Well, Pat had seen on a number of occasions the Reverend Father Wright, a man of small stature who lived next door, going into their garage carrying a small milking stool. Answers from his parents, to his questioning, were always vague."

The truth only came out years later. Access to the Out Station was gained by moving a shelf, which exposed a latch that opened a concealed panel. Father Wright needed the stool to enable him to reach the latch!



The main dimensions of the Zero Station. Drawn by Ian Hall

Alnwick Zero Station

The Zero Station is in an area of woodland to the north of Alnwick, built in the centre of an Iron Age defended settlement. The Control Station was in a Nissen hut nearby, the location of which is not known but was apparently "one hundred yards away" according to one of the ATS operators.

Today, the Zero Station is remarkably well preserved.

Part of an aerial cable still embedded in the trunk of a tree adjacent Zero Station. Photo Colin Anderson

Unlike the Operational Bases in the county, it is on higher and dryer ground, which has perhaps saved it from the ravages of damp and corrosion. Being inside the hill fort has probably also helped.

I first found the Zero Station in 2007. It was after I retired in 2010 that I managed to get permission from the landowner, the Duke of Northumberland, to properly examine it. Together with Colin Anderson, a colleague from the Pillbox Study Group, we cleared out the years of accumulated leaves and stones and were able to get a very good view of the structure.

The entrance is a vertical brick shaft which would once have been covered with stones. The design is what I would say was typical. The escape tunnel has been made with concrete drainpipes, but it only exits a few tens of yards from the entrance, and is in clear view from there. (By contrast, the local Operational Bases tend to have escape tunnels which exit at a point which is at least not easily visible by someone standing at the entrance.)

One of the Alnwick ATS operators, Janet Wise, remembered:

"Our station in Alnwick was, I think, extremely good. We were right up on a hill about five miles outside of Alnwick on the site of some old Roman castle. A part of the old Roman wall was the entrance to our Zero Station. What happened was, that one pressed something in the wall and it just sort of came out and down we went, thirty feet or so, to what we hoped looked just like an underground petrol store. It was a small area which was lined with these shelves all stacked with this petrol. Then you pressed something and one of these things just swung-out and then you had two chambers behind."

The original escape tunnel door being held in position. Photo Colin Anderson

Inside, all the 'furniture' is no longer there, but in amongst the rubbish we were able to find a couple of the doors that would have separated the various rooms. The various tubes that provided ventilation will still be underground, but they were all blocked with debris. It would be interesting one day to properly research the site

The mysterious tubes in the Zero Station. Photo Colin Anderson

and find where they all lead to.

Mysterious Tubes

Within the entrance chamber there are two metal tubes which I originally thought might be for passing messages to the ATS operators, using the 'split tennis ball' that we read about. But more recently I think it might have been to provide notice that someone was entering, by dropping a glass marble into the tube at some remote place. Any thoughts about this would be very welcome.

Within a few hundred yards of the Zero Station there is a pillbox, part of the Alnwick–Wooler stop line. One of the four such defence lines in the county, this is well preserved, with only one of the original pillboxes not surviving.

An intriguing footnote to the Alnwick Control/Zero Station is found in John Warwicker's book, *Churchill's Underground Army*, and relates to the infamous Rudolf Hess flight. There is some conjecture that a transmission from the Alnwick Special Duties Section radio provided navigational assistance to Hess as he changed track on his flight to the Duke of Hamilton's residence at Dungavel, Lanarkshire.

Back to the Future

So what about the future? It would be a tragedy if all the remains of the Auxiliary Units were to be lost from Northumberland, but it is not easy to see what the options might be. The Zero Station would seem to be the best candidate for preservation.

Following the 'clean up' in 2010, I contacted English Heritage and eventually they did amend the statutory protection for the Iron Age enclosure to include the Zero Station, but of course this provides no remedy to the ravages of time. Approaches to the landowner to discuss options have so far not been successful. The publication of the book about the AUs and the resulting publicity in the local media might well provide the opportunity to awaken some interest in this part of our history.

A Silesia Weekend – October 2015

Martin Dixon

Conveyor junction at the Nowa Ruda coal mine. The authentic equipment and warning notice date from its use as a training mine. Photo Chris Wilkins

The latest weekend organised by Raf Marcinkiewicz and Chris Wilkins took us to the ancient region of Silesia. This territory has changed hands many times over the years and is today part situated in southern Poland with a thin band in the northeast of the Czech Republic. The area is rich in mineral deposits and we were to visit two mines as part of the trip. But the major focus was on the defensive structures in the Czech Republic along the current Polish border that were rendered impotent by the ceding of territory to Germany in 1938.

The impressive Centennial or People's Hall in Wroclaw. Photo Sue Monsell

Most of the twenty-one attendees arrived on Thursday on the 0835 flight from Stansted. Meeting up at the Wroclaw airport tourist office, we stocked up on maps and guides and half took taxis into town while the rest used the public bus – a bargain at three zlotys (about 50p). For one of us the bus ride turned out to be rather more expensive – £60.50 to be exact. He (name omitted to save embarrassment) left his baggage in the terminal by accident and on return incurred a fine of £60 for his troubles and for causing a partial terminal evacuation. So Wroclaw Airport does have left luggage facilities but at quite a price!

Centennial Hall

The afternoon was free so small groups ventured here and there on the excellent tram system. A few of us visited the World Heritage-listed Centennial Hall, built in 1913 to commemorate the 100th anniversary of the defeat of Napoleon at the Battle of Leipzig. Designed by Max Berg, the structure was the largest reinforced concrete dome in the world at the time and stands an impressive 42 metres high. After World War II, the Soviets rechristened

it as the 'People's Hall' and installed a large exhibition celebrating the People's Republic of Poland's 'Recovered Territories'. These were areas occupied before the war by Germany and returned to Poland governance (albeit under Soviet influence) and names.

As part of this exhibition, in 1948, a high metal structure called *Iglica* ('needle') was erected adjacent to the hall. Originally 106 metres high and topped with spinning mirrors, this towering monument was prophetically struck by lightning a day after completion and is now reduced to a still-impressive 96 metres in height.

Today there is an informative, English-captioned Discovery Centre which describes the structure and its architecture and construction, alongside contemporary political events. There cannot be many venues in the world which have hosted speakers as diverse as Adolf Hitler and Pope John Paul II. To round off the visit a large lake alongside the hall has an extensive fountain system that once an hour performs a choreographed display to music – a watered-down version of the famous Bellagio fountain in Las Vegas.

Through the wardrobe

Dinner that evening was individually arranged but most of us headed for the *Konspira* restaurant just off the main square. This offers traditional Polish workers' food at reasonable prices. The menu and decor reflects the fight against Soviet domination by Solidarity and other organisations. The menu contains some political history and contemporary cartoons but the star attraction is the conspirators' room.

This is a back room decorated as a Polish 1960s living room with all the paraphernalia of the resistance movement – posters, flags, typewriters and duplicating machines. It is ingeniously entered through the back of a wardrobe and thanks to Tony Radstone's arrangements we were lucky enough to be given the dining table there for our group. Intriguingly we were visited by other shadowy guests throughout the evening which added to the sense of our being (at least figuratively) underground.

As Friday dawned we breakfasted in the hotel and found the three late arrivals were with us as was John Coates who had taken the opportunity to do a side-trip to Krakow. The other group in the hotel seemed to be from the WI (Wroclaw Institute?) who certainly didn't look as if they were looking forward to their day as much as we were.

Gertrude's Level (from the German) dating from 1920 at Złoty Stok Gold Mine. Photo Clive Penfold

Our comfortable mini-coach and driver arrived on time and we set off to our first site of the weekend – *Złoty Stok* (literally Golden Slope) gold mine. Gold was first exploited in the stream outside the current mine and underground extraction began in the first half of the 16th century. We were greeted by a jovial guide with good English and our exploration began.

A Gneiss time

We entered the youngest adit dated 1920 and labelled, in German, *Gertruds Stollen* or 'Gertrude's Tunnel or Adit'. For much of the mine's life it was in German territory and hence follows German practice. The bedrock is largely gneiss with shale bands and the harder rock was in the early years split by hammering wooden pegs into bored holes and then expanding the pegs with water to split the rock. Later fire setting was used where the rock is heated by fire and then shattered with water but care has to be taken with the noxious gases released; gunpowder was first used in the mine in 1612. Gertrude Adit was only used for transport, and serviced the production areas of West and Cross Mountain.

Authentic tunnel at Złoty Stok through a more stable gneiss horizon. Photo Chris Wilkins

We firstly visited the museum's exhibition area in the brick-lined former explosive store where techniques, artefacts and the mine's history were documented. As the gold was found in an iron-bearing bedrock, a compass was used to locate potential rich areas. The original galleries were around one metre by 70 centimetres but became larger when explosives and rail transport were introduced. The wagons were known as dogs as they made a characteristic barking noise when underway. The yield was around 5g of gold per tonne of ore; arsenic was also found and exploited.

Over the life of the mine it yielded around 16.5 tonnes of gold – worth around £400 million at current prices but would have occupied an 80cm cube in total! The exhibition also showed the separation process which used molten lead in graphite crucibles.

The bricks and shuttered concrete roof (believed to date from World War II) show a marked contrast with the raw adits beyond at Złoty Stok. Photo Chris Wilkins

Reconstructed supports at Złoty Stok gold mine, showing the dense timbering used through areas of instability. Photo Chris Wilkins

Health and Safety

The facts and figures complete, we then descended to lower levels to explore the mine itself. We took a slide (one of the features to amuse children) to a lower level and were faced with an extensive display of original Health and Safety signs dating from the latter years of the mine. These were far from subtle and included the blunt *Do not pee in the washbasins*, the enigmatic *After finishing work, put on your underpants* and my favourite *Do not try and mend machines whilst they are operating, otherwise you'll end up wiping your arse with your elbow.* Exiting this part of the mine we climbed to a higher level and entered the Black Upper Adit.

Higher up we could see a small 16th-century adit but we entered slightly lower in the more generously proportioned 18th-century level. We descended by a modern spiral staircase to the Black Lower Adit where we hoped to see Poland's only underground waterfall. Sadly because of the lack of recent rain we had to be satisfied with Poland's only underground waterfall chamber. This lower-level adit was a transport level and had been used by the Germans in World War II for storage and shelter; a few remains of blast walls were still visible.

On a short detour off the normal route we saw a large shaft which had once housed a lift of which the huge

The splendid array of safety signs at Złoty Stok, imploring workers what to do (and not to do!) to ensure personal safety and hygiene. Photo Chris Wilkins

counterweight could still be viewed. Our tour complete, we boarded carriages of the 50cm railway and sitting astride benches made our exit from the mine. The guide told us that they still found gold in the mine but this turned out to be a Polish pun as the word Zloty is both the name of gold and of the Polish currency and tourists occasionally drop a few coins in the mine. Overall it was an interesting visit but perhaps over-geared at children with rather too many mentions of rats and bodily functions.

Entrance to Black Upper Adit at Złoty Stok. As well as this 18th-century entrance, a much smaller 16th-century entrance can be seen directly above the left-hand side of the lower entrance. Photo Clive Penfold

Remains of a World War II blast door at Złoty Stok when the area was used as an air-raid shelter and/or ammunition store. Photo Clive Penfold

From Gold into Silver

From Golden Slope we now drove to *Srebrna Gora* or Silver Mountain. The town was founded when silver extraction commenced in the region in the 14th century. After the area was occupied by Prussia, the town gained new significance when a huge fortress was built to protect the territory and specifically the Silver Mountain Pass. However this prominence was short-lived as the town was almost completely destroyed in the siege of 1807.

Over later years the fortress lost its military role but instead became a tourist destination. We were to continue this tradition and ascended steeply about a mile to reach the hilltop castle at the centre of the pass's defences. En route we were treated to a fine example of (non) Health and Safety in action – a roofer balanced on a single lath whilst cutting the same to length with a chainsaw held in one hand. Not a hard hat or working platform in sight and the safety rail was actually the incoming electricity supply.

The imposing entrance to the Donjon Bastion at Srebrna Gora. Although curved, there is still a line of sight through to the main magazine beyond – a potential defensive weakness. Photo Chris Wilkins

After a brief stop to catch our breath and enjoy a coffee, our guided tour started led by a chap dressed in the uniform of an 18th-century soldier. The fort is in the middle of a 700,000 Euro restoration although in the eyes of some of the party, a 700 million Euro over-restoration. We entered into Donjon – the bastion of final defence across what would once have been a drawbridge. The largest room within has been rebuilt to host functions but would once have been the armoury, holding 6,000 rifles.

We then descended a brick-lined passage within the native rock to a sally port. At the end could be seen the positions of two doors – the inner being a vertical portcullis. In normal times the gap between the two would have been packed with sandbags for additional protection. If the doors had been breached by the enemy, the passage would have been mined so access could be cut off – a principle repeated in Maginot Line forts and similar in the 1930s.

Our next stop was a 60m deep well which would have been worked by a man-wheel. Some of the many

Descending passage in Srebrna Gora Fortress that leads down to the well and sally port. Photo Clive Penfold

casemates held artefacts including a large collection of cannon balls and the remains of a massive grenade. In another casemate our guide gave a demonstration of flintlock firing which produced a significant blast wave as well as testing the integrity of our eardrums. Time considerations meant we couldn't visit the entire site but emerging back into daylight we just had time to walk around the battlements admiring the superb views over the neighbouring countryside. The leaves were just starting to turn for autumn and all weekend we were treated to a fine palette of yellows, oranges and reds.

Back to School

Our final site of the day was a coal mine – but one with a difference. The mine in *Nowa Ruda* ('new ore') operated from 1868 until closure in 1995. Producing high-grade anthracite (highly efficient, although difficult to light), mining stopped when the cost to extract a tonne exceeded its market value. The difference is that although the production mine, with its main shaft of 550 metres, is no longer accessible due to flooding and lack of ventilation, another mine is. This is the training mine, built in the early 1960s to train new recruits. It contains a microcosm of a working mine in a small area just below surface level and it offered an authentic visit without relying on the 'sham' mines that many other museums now offer.

Our uniformed guide demonstrates the cat-o'-nine-tails to the party. (The worst offenders had already made their break for freedom!) Photo Clive Penfold

Headgear at the 'Lech' shaft at Nowa Ruda coal mine. The engine house (out of shot) is also still extant. Photo Clive Penfold

We started by donning helmets, the colour of which determined the role and experience of the wearer – green for trainee, brown for miner, white for supervisor etc. Yellow designated 'honey man', of which more anon. We entered a miners' cage but didn't descend and instead went through a number of twisting passages which were used to simulate mine rescue. Entering the training mine proper, we then embarked along a series of working exhibits which showed all aspects of coal extraction.

Hydraulic props and conveyer belt leading from the Nowa Ruda simulated coal face. Photo Clive Penfold

The mine is equipped with a 43cm railway, all in working order; we followed the tracks to see an example of an 'overthrow' coal loader operated, like much underground machinery, by pneumatic pressure. Next came a working conveyor belt which was used to transport miners as well as coal from the working face. We finally arrived at the coal face, complete with hydraulic jacks and coal ripper, both of which we saw in operation and provided a safe(r) environment but an authentic recreation of life underground.

Honey Honey

Our next stop was an ambulance carriage, then a young girl on the same tour showed the power of the ventilation system by standing in front of an extractor inlet; her hair literally standing on end! Nearby was a small area where we could use pneumatic picks and drills 'hands on'. There was also a pneumatic light, something I have seen before in France but never the UK.

To reduce the risk of sparking and to use a power source already on hand, this uses a small turbine to power a dynamo, all integrated with the light itself; very neat and impressive. Finally in this section were a couple of miners' toilets, the responsibility of the 'honey man'. Never stand in the way of a miner in Poland wearing a yellow helmet!

Compressor at Nowa Ruda coal mine. Photo Chris Wilkins

Different sorts of wooden tunnel support were shown alongside each other – German, Swedish and Polish. The Polish design was arched and hence stronger but took more skill to assemble. The passage led to a recreated underground stable – of particular interest to me as my grandfather was an underground horse keeper in the Barnsley coalfield. Our guide told us that the mine had 647 horses during its working life. A passage from the fascinating 'training mine' led to one of the working shafts – the water table was now around 15 metres below us but around 45 metres of shaft stretched above us. Adjacent to this shaft is the last load of coal to be mined along with a memorial to the many miners who died whilst working here.

A final touch was a ride back to daylight on an original mine carriage – a cramped and uneven ride but preferable to walking. This left us with 30 minutes or so to view the small surface museum dedicated to the site. Included in the exhibits were the ceremonial feather-trimmed hats traditionally worn on St Barbara's Day (4 December). St Barbara is the patron saint of miners and the colour of the feathers indicated the miner's role – an early precursor to today's safety helmets. There was also an exhibit on

mining disasters including the worst to strike the mine in 1941 when 187 died, including one British prisoner of war. For those with a thirst the bar here was constructed of tunnel and face supports with mine wagons forming the bar proper.

Transport level at Nowa Ruda coal mine. Photo Clive Penfold

Original entrance to one of the winding shafts at Nowa Ruda. All of the lower levels are now flooded. 43cm gauge track can just be discerned entering where the cage would have been. Photo Clive Penfold

The mine train by which we returned to daylight in Nowa Ruda. It operates on a 43cm gauge. Photo Chris Wilkins

Visits for the day complete, we drove to our accommodation for the next three nights – the Hotel Marhaba in Kłodzko. The hotel had helpful staff and tasty food but the rooms were on the basic side and the curtains decorative rather than functional. Their website promised 'occasional raves' but we were left to make our own entertainment with beer at around 90p a bottle and a nearby mini-mart providing port and cherry brandy for those with a more sophisticated palate. A display cabinet in reception offered an eclectic mix of exhibits, presumably souvenirs from the owners' travels. These included a phial of Saharan sand, a postcard of the Coliseum and a German dragon carved out of a coconut....

Control Room for Nowa Ruda coal mine. On the plan on the left, we visited just the tiny portion coloured orange. The speakers on the right were used to broadcast warnings but could also listen in – hence their nickname as 'pig's ears'. Photo Clive Penfold

Czech Point Charlie

Saturday dawned and after an early breakfast we were on the road by 0800. The views were curtailed by heavy mist as we sped towards the Czech border. Climbing steadily we entered the mountains and could see the area was used for winter sports in the season. We missed one turn but soon retraced our steps and drove to the Hanička Artillery Fort. Chris had asked for permission to drive along a forestry road to the site to save a 30-minute walk. Whether permission had been finally granted was a little uncertain but we agreed to indemnify the driver against any potential fine should we pass a Czech point.

Hanička artillery fort was the first of several fortifications we were to visit that formed part of a defensive chain to protect the then Czechoslovakia against Nazi Germany (see separate panel). Named after the nearby village (literally 'Little Hannah'), the fort was constructed between 1936 and 1938 by the Bedřich Hlava Company of Prague. It was to have been garrisoned by 426 soldiers but the site was handed over to the Germans without a shot being fired on 10 October 1938. If completed, the fort's armaments would have included one artillery casemate, one artillery turret and three infantry (machine gun) casemates.

Postwar, the site was used to supply drinking water to the nearby town of Rokytnice. In the 1950s much of the remaining metal, incuding turrets, was removed by the Kovošrot scrap metal company, apparently without authorisation. A brief period followed when the site was

used as a vegetable store but difficult access in winter made this impractical. Another unusual use was for testing a communication system for the Prague Metro system. In 1969 for a period the fort was opened to the public but this came to an end in 1975 when the site was requisitioned by the Czech Interior Ministry.

Water storage and distribution at Fort Hanička. This equipment dates from the Cold War and is installed in a former ammunition store. Photo Chris Wilkins

Turniket (Turnstile)

Modifications to the site began in 1979 to turn the fort into a nuclear bunker, designated as the command post for the Department for Home Affairs – broadly equivalent to the UK Government HQ beneath Corsham. Codenamed *Objekt Kahan* ('Burner'), other nearby sites would have provided backup and communications support. The surface buildings were secured and shafts blocked off while the underground corridors and chambers were re-equipped with modern plant and accommodation facilities. Work continued until 1993 when work stopped; the bunker still unfinished despite the expenditure of hundreds of millions of *Koruna*. Now the property of the local town, the fort now operates as a museum with surface exhibits and guided tours.

Entrance lobby of Fort Hanička. The cabling dates from the incompleted conversion to a Cold War government shelter. Concrete spalling around the light shows that the original reinforcement was perhaps rather too near the surface. Photo Chris Wilkins

Entering a surface compound, we had time to look round a collection of vehicles and artefacts before the tour began. These included a rare cupola (most were scrapped) or, as termed by the Czech military, an 'offensive cloche'. Other exhibits included a 'Lizard' anti-aircraft gun, a T34 tank and an OT810 half-track Armoured Personnel Carrier. A surface building had been added in the Cold War and this rather shoddily-built addition now houses an exhibition including some superb models of the fort at 1:35 scale. Our journey underground then began, descending 98 steps to the communication corridor. Side passages off the corridor held three 1980s generators, with diesel storage adjacent. There were also tanks for drinking water and sewage holding tanks. The rest of the side passages (originally grenade stores for the howitzer) held a decontamination suite, a technical control post and air handling plant. Unfortunately, visitors are only allowed to view these from the main tunnel.

Generators dating from the 1980s in Fort Hanička. Photo Clive Penfold

Caserne and casemate

Moving on down the tunnel from the plant area, we passed through gas-tight doors. After around 300 metres we reached the barrack area or *caserne*. All signs of the World War II narrow-gauge railway had been concreted over. The distance from the entrance to the barrack area is generally slightly longer than in the Maginot forts whereas the distance to the fighting casemates is a little shorter. The barrack side passages had again been modified in the Cold War but had been partially stripped out. The forward machine gun ammunition store had become a dining room and small hospital which still retained some medical equipment. Dormitories complete with bunks and smaller rooms for officers were alongside and a toilet block was also still in place.

We continued along the main corridor for perhaps another 350 metres to reach one of the infantry blocks. This involved another lengthy stairway up to the surface. No guns were in place but the firing points could be seen – the ladders up to the turrets had all been removed. The

The 'Maginot Line' of Czechoslovakia

The extensive Maginot Line defences in France, built to defend the border with Germany, are well known. What is little known however is that pre-World War II Czechoslovakia built a very similar set of border fortifications on its frontiers – especially on the northern border with Germany. The trigger for these was Hitler's demands for the reunification of German minorities, mainly in the so-called Sudetenland. The bulk of the network was built after discussion with the French military and their similarity to the Maginot Line is striking. They are sometimes referred to – but not by the Czechs – as the Beneš Line (after the second President of Czechoslovakia 1935-38, Edvard Beneš) .

Construction began in 1936 with a planned completion date of 1942. By 1938, 264 heavy defences such as forts and casemates were complete as were an astonishing 10,000 light defences such as pillboxes. Many of the other structures were near completion although few of the heavy armaments had been installed. The largest fortresses (like the grands ouvrages of the Maginot Line) were known as tvrzi (strongholds) and consist of a heavily defended entrance block, linked by deep underground tunnels to five or six 'fighting' blocks or casemates. One or two of these would have typically housed artillery pieces (cannon and howitzers) and the others light and heavy machine guns and observation posts.

Most of this preparation was rendered impotent by the Munich Agreement. This agreement (referred to by Czechs as the Munich betrayal or diktat) involved France, Germany, Italy and the United Kingdom and is famously recalled in Chamberlain's return to London clutching the agreement and claiming 'peace for our time'. The agreement, signed on 30 September 1938, allowed Germany to occupy Sudetenland on the basis that this would be the limit of their territorial demands.

Czechoslovakia thus lost almost all of its border defences as well as the majority of its power and iron and steel production and was left with no real option but to accede to the Agreement. Of course, Hitler's subsequent invasions made the Munich Agreement an empty promise.

Although the defensive hardpoints were not taken by force, the Germans nevertheless used artillery against them, in order to assess the effectiveness of their own weapons. Some of the forts on the eastern boundary of Czechoslovakia were briefly used against the Soviet Red Army in 1945. Postwar, a few of the larger forts were retained by the army and used for ammunition storage and a smaller number were redeveloped as Cold War command centres. For the rest, however, any remaining metals were scrapped, leaving concrete shells.

Several of the sites are now open to the public and we visited four of these museums – each having a different end-state despite almost identical layouts.

casemate was surrounded by a dry moat and grenade tubes were still in place that would have offered a defence against close quarter attackers.

Exiting to the fresh air, we admired the outside of casemate R-S 76. This is arguably the best preserved in the Czech Republic and retains embrasures and cupolas for both light and heavy machine guns. There is also an observation cupola for the nearby artillery casemate. A small ventilation cupola completes the set up. The positions had the highest level of resistance when built – designated class IV. This includes walls of 3.5 metres of reinforced concrete and cupolas of 30cm of high-quality steel; each cupola weighed around 56 tonnes.

A Star is born

Photography over, we ambled back to our entrance point. En route we passed one of the other turrets which would have held a 10mm howitzer but the turret here was long gone. One of the advantages of visiting museum sites is the availability of coffee, toilets and a small bookshop so having availed ourselves of some or all of these we reboarded the bus. Our destination was Josefov, an outstanding example of an 18th-century 'star' fort. The town retains much of its original splendour and a film crew was at work as we arrived. The story was obviously set in World War II as German trucks and swastika-emblazoned ammunition boxes lined the street.

Reproduction ammunition boxes at Fort Josefov; these are part of a film set but added atmosphere to our visit.
Photo Chris Wilkins

Just as the 1930 Czech defences mirrored those of the Maginot Line, so this much earlier fort was very similar to the French cities fortified by Marshal Vauban. It

bears a striking resemblance to fortified towns such as Arras, Lille or Gravelines. This is not surprising as it was designed by a French architect (Claude Benoit Chevalier de St. Luis Duhamel de Querlonde) and built between 1780 and 1787. The walls and moat protect around 266 hectares so it was far more than a military garrison. Its structure includes an amazing 45 kilometres of underground shooting galleries, passages and countermine galleries and in total the construction apparently took an astonishing 400 million bricks.

A typical view of Fort Josefov and just a few of its 400 million bricks. Photo Clive Penfold

The aim of the fort was to protect the northern boundary of the Austrian Empire against the ambitions of the Prussian Empire. It was never besieged but the defences would certainly have made a formidable obstacle to breach. We entered the fortress through the site of one of the now-demolished four gates between two of the immense bastions. We were on a guided tour with a group of Czech tourists – an arrangement that probably irritated both groups in equal measure.

About to enter Fort Josefov. The ramp in the centre leads up to the ramparts. Photo Clive Penfold

Mine and Countermine

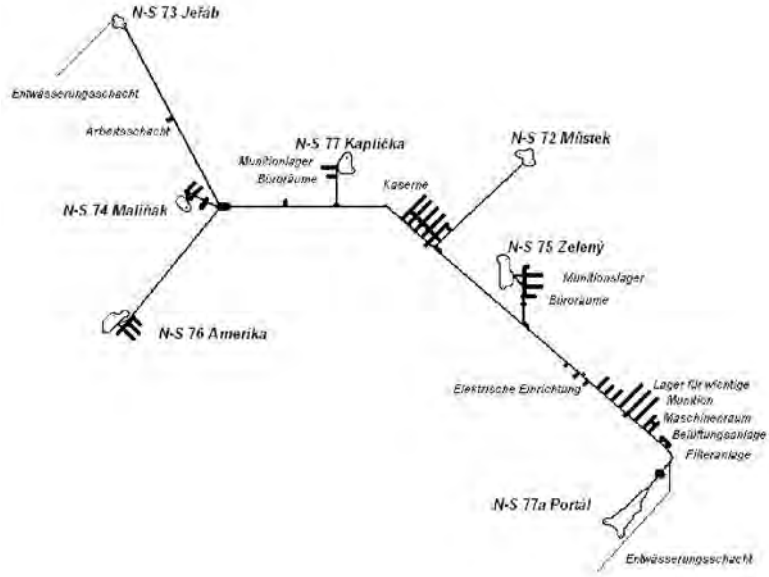
Our underground trip began with a shooting gallery, with good line of fire into the dry moat. We then ventured into one of the three levels of countermine gallery, where listeners would have located enemy miners and extended the galleries to lay explosives. There were 762 different countermine galleries – a complicated network for the defenders to navigate by candlelight. We had free rein to explore some of these passages that got smaller and smaller until the only way back was to crawl backwards. We were given candle lights but most opted to use torches – helpful for examination and photography but arguably destroying some of the atmosphere. We could, however read the English handout more easily.

A typical underground gallery at Fort Josefov. The archways just visible to the right lead to countermine galleries. Photo Chris Wilkins

To make navigation for the soldiers easier, most of the passages are numbered. If necessary, the defenders could navigate in the dark and these numbers are raised so that they can be read by touch – an early predecessor to Braille. We were encouraged to walk the final part of our tour in the dark – an interesting exercise. The guide indicated that she was too afraid to join us for this section but obviously had a short cut as she was ready to welcome us back at the end of our twisting transit.

Barracks at Fort Josefov. Photo Clive Penfold

Leaving the 18th century behind, we returned to the 20th and drove to our final site of the day – Dobrošov Artillery Fort near Náchod. This is another 1930s fort, where construction started in 1937 but was never finished. When the Munich Agreement was signed, this fort (unlike most) was not part of the German-speaking Sudetenland but construction work by the 490 builders still stopped as to defend the border the full network of forts was needed. The fort came under German control after the invasion of 15 March 1939. Postwar, it lay unused until 1968 when the site was first opened to the public. After some restoration and reinstatement, a through trip is now possible.



Plan of the unfinished Dobrošov Fort. The planned entrance at the bottom (N-S 77a) was never completed. We entered through the artillery casemate N-S 75 (Zeleny) and exited via the infantry casemate N-S 72 (Mustek).

As we arrived just before the scheduled closing time, Raf had to work hard to persuade the ticket office to allow us access. Their first proposal was that we join a large coachload of Czechs who had just arrived and were making just a short visit but the custodian eventually allowed us access without a guide which was welcomed. One major difference with the Maginot Line forts is that the Czech version only had a single entrance for both personnel and ammunition whereas the *grands ouvrages* of the French version had separate entrances. When work on the fort stopped, this entrance block and connecting tunnels had not been completed. Because of this our entrance was through the artillery casemate where a reconstructed gun had been built in wood to illustrate the planned armament.

The modern-day entry point to Fort Dobrošov through the artillery casemate N-S 75. The embrasure surrounds are modern replacements. The dry ditch in front of them is defended by grenade chutes. Photo Clive Penfold

Bunker Busting

Although unfinished, around two kilometres of underground passageway were completed (in various states of finish) and we descended 171 steps to reach them. Alongside was the shaft for a massive lift which made awesome viewing. At the foot of the stairs were a couple of forward ammunition stores, now laid out with some recovered artefacts. These included a disassembled heavy machine gun ball and socket fitting and a German 'bunker busting' Röchling shell. The latter was a very narrow artillery shell with a high mass (increasing sectional density) with rear vanes that deployed after firing.

Trials, many against the captured Czech defensive line, showed that these weapons could penetrate up to four metres of reinforced concrete but despite the vanes, accuracy remained a problem. Their developer August Cönders was also responsible for the V3 pump gun at Mimoyeques in France, visited on previous Sub Brit trips.

From these side galleries we briefly headed towards where the original entrance corridor would have been. Although substantially excavated, this

The unfinished entrance corridor at Fort Dobrošov. This shows the shale bedrock including a few rockfalls. In the distance a mirror has been placed to show the intended length. Photo Clive Penfold.

remains unlined and gives an interesting perspective of work-in-progress. A spotlight was cleverly set up to reflect off a distant mirror, showing the extent of the excavation of perhaps 250 metres. From here we reversed our steps and proceeded to what would have been the underground barracks. Most of the passage is lined with shuttered concrete but in places had been repaired with arched mine linings, after collapses in 1969.

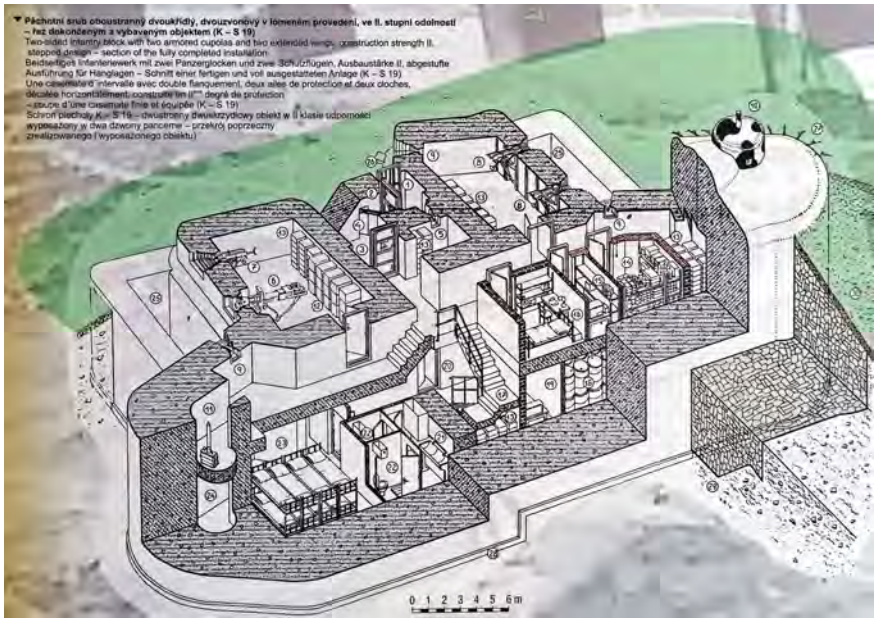
The passages appear over-high but the invert is missing both a drainage pipe and narrow-gauge rails and the crown would have been destined to hold ventilation and a set of electrical and other cables. The barrack side passages are also largely unfinished but notices indicate their planned function including dormitories, kitchens and toilet facilities. Another unfinished and blocked passage led off to Blockhouse *Jeřáb* ('crane').

Arched mine supports installed in Fort Dobrošov to allow tourist access after collapses in the 1960s. Photo Clive Penfold

The 226-step stairway leading from the communication level to the infantry casemate at Fort Dobrošov. Photo Clive Penfold

Fort Dobrošov main corridor. Behind the camera is the unfinished entrance corridor; the right-hand corridor leads to the current entrance through the artillery casemate. The passages appear over-height but were never laid with drainage or rail tracks plus the overhead would have held wiring and ventilation tubing. Photo Clive Penfold

A couple of hundred metres from the barracks we arrived at the base of Casemate N-S 72, codenamed *Mustek* ('bridge'). Here 226 steps (a lot of counting on this trip!) led up to the surface casemate, much modified by test firing of the bunker-busting weapons described above. Also waiting for us was the irate custodian. It had not been made clear what time she was expecting us to exit but it was obviously before now and she wasn't keen on working overtime! The outside face of Mustek also showed the scars of test firing. En route back to the coach we passed the flattened remains of a small pillbox and an impressive array of anti-tank obstacles – colloquially known as hedgehogs or *ježeks* with barbed wire entanglements. .



Cutaway drawing of an infantry casemate at Bouda with two cupolas and two armoured wings. The lower level includes bunks and bathroom whilst the upper floor holds ammunition and the Commander's Office. Photo Clive Penfold

A Frosty Reception

Returning into Poland to our hotel, we had time to freshen up before a home-cooked meal of tomato soup and turkey. To supplement the single option of wine that the restaurant had in stock, the local shops provided some excellent options at around £2.50 a bottle (and no corkage!). Sunday dawned all too soon for another early start. Tony Radstone realised the folly of leaving his key in the outside keyhole of his room but was soon released to join the rest of the group. Mist accompanied the first part of our journey but this soon lifted to provide some more splendid views as we drove back into the Czech mountains. As we drove up to 990 metres, frost appeared to add to the scenery.

Our first site of the day was Bouda Fort, one of the forts that was structurally complete by 1938 but lacked its heavy armament. The walk to the entrance from the car park through the forest took around 50 minutes and we arrived raring to go. However it turned out that we couldn't enter until 1100 so we had lots of time to enjoy a cup of coffee from the makeshift cafe operated by the museum volunteers.

We could study the entrance which had a folding barred gate and the site of two armoured doors with associated machine gun defences. Although apparently original, the embrasures were most likely reused on the Atlantic Wall and the area had in fact been patched up and rebuilt in 1950 when the site was being considered as an active military facility.

The substantial entrance to Bouda Fort. Behind the barred gate would have been the first of two armoured doors. The machine gun cloche to the left was placed as a museum exhibit in recent years. Photo Clive Penfold

Our tour proper began at this entrance block (K-S 22a) with a 15-minute description in Czech of what we were about to see. Your scribe and others in the party felt that such a tour was unlikely to satisfy our expectations and after a little persuasion the museum provided a second guide who would act as our escort but not subject us to long descriptions in a foreign tongue. We also got a copy of an English handout which described the fort's key features. Thus we moved into the bunker proper – shortly inside was a loading area for the narrow-gauge railway, leading to a 17-metre-long rail incline. Wedge-shaped carriages kept the load horizontal but carried the narrow-gauge wagons themselves rather than loose loads to minimise loading and unloading. At the bottom of the incline a drainage passage led off to the right, draining waste water into the valley below.

Inclined plane for transport down to the main communication galleries at Bouda. Only one of the two original tracks remains. A complete wagon is carried on the carriage to minimise unloading. Photo Chris Wilkins

Shortly beyond this tunnel were two chambers, one on each side of the passage. These would have held explosives so that security could have been maintained in the case of a breach of the main entrance. Beyond this were chambers for the usual vital services such as filter rooms, ammunition dumps and spaces for generators, fuel and water.

Sliding Doors

The next section of passage had some unusual features – two solid concrete sliding doors mounted on tracks at right angles to the passage. These were experimental doors installed by the Germans in the 1940s in order to test different designs. Large-scale executions of the chosen design can be seen at some of the V-weapon sites in northern France such as Eperlecques whose examples weigh 213 tonnes versus the c20 tonnes of these test versions.

Sixty or so metres further on was a small loading or transshipment bay where the narrow-gauge locomotives were also maintained. Although the heavy armaments were never installed, the ammunition store here held around one million rounds of 7.92mm machine gun ammunition by 1938.

Rail siding and unloading platform in Bouda. This leads into one of the large ammunition storage chambers off the main corridor. Photo Chris Wilkins

The main access corridor at Bouda, showing an unloading platform and siding to the left. Photo Clive Penfold

Further on, left and right were two half-finished chambers, part of the proposed 1950s renovation and valuable in showing the native rock. Today these form an important bat hibernation spot. Three cable lobbies also lead off

and a cable shaft leading to the surface 50 metres above can be seen at the rear of each one.

As expected, the barracks area here was soon reached but the use of each area could only be determined by the traces of wall footings on the ground. Apparently the local residents reclaimed the material here in the late 1950s onwards for use above ground. Nevertheless, toilets, hospital and dormitories could be made out with reasonable certainty.

Side passage under construction at Bouda. This is part of the uncompleted 1950s project to reuse the site for ammunition storage. Photo Chris Wilkins

Emergency Exit

Going onwards we passed one of the original construction shafts – now backfilled but containing an emergency exit for use if, for example, the main entrance had been mined. This was again similar in design to the Maginot Line – two slightly offset concrete lined shafts with a ladder or step irons within. The upper of these was filled with gravel to make entry from the top extremely difficult. When exiting, this gravel could be released into a separate lower chamber from the top of the ladder at the top of the lower shaft.

We were now under the artillery block S 22 which would have held a 100mm gun in a retractable turret. At passage level were rooms for a fire control centre and commandant's office. Next door were two magazines which would have held around half of the 100mm shells (say 2,600). The entire artillery gallery would have been isolated in combat by gastight doors. Ascending the stairs to the business end of the casemate, we reached two surface/subsurface levels.

On the lower level was a used-shell room, complete with intact chute, and crew rooms including the site of a toilet. On the top level we were able to enter the circular shaft where the turret would have been installed which measured eight metres in diameter and about eleven metres in height. The turret would have weighed around 120 tonnes, with a counterweight of the same weight. Adjacent to the turret were other rooms – presumably forward ammunition stores and technical services. The range of around 12km would have overlapped with neighbouring forts to form a fearsome barrier.

Apfel Strudel

Retracing our steps to the entrance block, we exited the fort. En route we passed the same Czech group being bored by the same Czech guide – showing that a passionate enthusiast is often not the best choice to lead guided tours. If we hadn't made separate arrangements we might still have been there! Back we climbed to the car park, and on arrival we were more than ready for the supplied packed lunches – supplemented by some with a local sausage and/or excellent Apfel Strudel from the adjacent cafe. Once all present and correct we set off for our final site – Hůrka Fort.

Ammunition boxes in one of the side chambers at Hůrka Fort. Photo Chris Wilkins

En route we passed across a valley floor where scores of pillboxes once protected the terrain – many of them still in situ. Hůrka Fort was the neighbouring fort to the east of Bouda, situated near the Czech border town of Kraliky. In layout it is virtually identical to Bouda, except that the ascent from the communication passages to the artillery and infantry casemates is even longer!

Narrow-gauge railway siding at Hůrka Fort. This was used for stabling wagons; a small room at the end of the siding was also used to service locomotives.

The main difference in history is that this fort was still in use by the Czech military as an ammunition store from 1958 until 2008. Hence some aspects of the site (eg the narrow-gauge railway) remain in excellent condition whereas original features of the underground barracks in

particular have been obliterated to create large storage magazines. In recent years a covered loading bay had been erected in front of the entrance to provide protection from the elements and although now removed, the ridge line could still be clearly seen.

Entrance block of Hůrka Fort with Czech 'hedgehogs' in the foreground. The barred gate is original, as are the railway tracks. When used as an ammunition store a loading shed was erected outside the entrance – the roof line of this can still be discerned. Photo Clive Penfold

The operation of this museum was definitely a 'one man show' with the same guy selling tickets, conducting tours, running the bar, and selling souvenirs. The good news is that Raf again negotiated for us to be free to explore on our own, provided we didn't cross any barrier chains.

This fort had its original doors at the entrance point and the inclined plane was in working order (although not seen in operation). The railway track was in good order including points, and a working battery loco was on site and apparently available for demonstration on special tours.

Mike, Adam, Nigel and Sue admire the battery locomotive at Hůrka Fort. This is operated for visitors on special tours. Photo Clive Penfold

Going Up

We followed the same route as earlier in the day and found ourselves under the artillery casemate rather than the turret. It appeared that this section was normally reserved for special tours but as there wasn't a barrier as such most of us ascended. The climb turned out to be the longest so far – 285 steps or 52 metres. Whilst understanding the need for communication corridors to be well protected, this extreme depth still puzzles me. With the offensive weaponry of the period, surely a much lower depth would have sufficed? In addition, the stairs ascend in a single spiral in a single shaft so any penetration of the defences by shell or infantry could have dropped ordnance the full depth and caused the same damage had it been just a few metres beneath.

Junction in Hůrka Fort. The left passage leads to a 100mm turret but is gated apart from special tours. The right-hand passage leads to the artillery casemate. Photo Chris Wilkins

The sight awaiting us at the top was an extreme example of the damage caused by test firing of German shells. The massive thickness of concrete had been completely shattered and the reinforcing bar twisted into grotesque shapes. Another threat awaited us – a brown cave spider whose bite is apparently extremely painful (I looked this up on the web). Our exploration complete, we returned to the entrance building and regrouped over a beer to reflect on our exploration. Being a Sunday, back at the hotel some excellent roast pork was the order of the day.

The seriously impressive damage at Hůrka Fort artillery casemate, caused by test firing of German weapons. Photo Chris Wilkins

Tunnel Vision

One final site awaited us on Monday before departure from Kłodzko – a trip under the town where we were staying. Here, mediaeval cellars originally built for storage had been used in later years as shelters for the residents in times of conflict. In essence their history is

The scissor points at the top of the Hůrka Fort incline. The points are still in working order, as is the incline itself (a carriage can just be seen on the far left). Photo Chris Wilkins

the same as the *Boves* beneath Arras in northern France which have been a tourist attraction for many years. When buildings above the tunnels started collapsing in the 1960s, an extensive programme of restoration started which, as part of its legacy, has left a tourist route through many of them.

Displays document some of the historical uses with an over-emphasis (aimed at younger visitors) on instruments of torture. Nevertheless the tunnels formed an enjoyable *digestif* to our weekend. Most of us snoozed on the drive back to the airport or Wroclaw city, where luggage storage at our original hotel had thoughtfully been arranged for those with later flights.

The Sub Brit party about to enter the Kłodzko tunnels. Photo Clive Penfold

Tunnels beneath Kłodzko showing one of their former uses as a laundry. Photo Clive Penfold

As usual, we owe thanks to Raf and Chris as organisers of the weekend. We saw some superb sites in great company across two countries. All the sites we visited operate as public museums so it would be easy to recreate the weekend as an individual traveller or smaller group.

An en-suite twin room including breakfast at the Marhaba costs around £12 per person per night and the site admissions are mostly around two or three pounds each. Some of the sites offer extended or 'behind the scenes' tours which we weren't able to sample and would need arranging in advance. There are also other museums in the locality including a museum of vehicles and arms at Kralicky and some restored pillboxes and machine gun posts. Petr Koláček's book of Czech fortifications (see below) is in English and particularly helpful and good value at less than £2 a copy.

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Further information

http://konspira.org/ Konspira restaurant

www.kopalniazlota.pl/en/ Zloty Stok gold mine

http://kopalnia-muzeum.pl/index.php/en/about-the-museum/description-museum Nowa Ruda coal mine

www.hanicka.cz/ Hanicka Fort

www.pevnostjosefov.cz/?lang=en Fortress Josefov

rmn.wz.cz/FORT-DOBROSOV.html Dobrosov Fort

www.boudamuseum.com/en/index.php Bouda Fort

www.boudamuseum.com/en/Museum_of_fo_1.php Hůrka Fort

Dingle Liverpool Overhead Railway station tunnel update

Paul Wright

Looking west at the site of Dingle station from the access ramp. This is the point where originally a pedestrian footbridge gave access to the island platform of the station. The view shows the massive volume of material that fell into the tunnel

The Liverpool Overhead Railway (LOR) opened its southern extension to Dingle on 21 December 1896. The original line had opened on 4 February 1893 and served only the dock areas – its history and later tunnel collapse were first featured in detail in Subterranea 31 (December 2012). Although busy in the daytime it was very quiet in the evenings when the working day was over as it did not link to any residential areas. Dingle had grown into a large residential area by the 1890s and the LOR realised that they could increase revenue if they could serve it. Unlike the rest of the line the southern extension was almost entirely underground and this included the station at Dingle. The station was situated in a 163yd long tunnel that had been built using the cut and cover method. Within the tunnel there was an island platform with two faces. It was accessed via steps that ran down from street level in a subway. The station proved to be popular with local residents who now had a direct link to the Liverpool dock system. The line was electrified from the start and trains ran at a high frequency.

On 23 December 1901 there was a serious fire at Dingle station which claimed six lives. An inbound train caught fire on the approach to the station and a strong breeze that was blowing through the tunnel fanned the flames. The station was out of use for over a year.

The LOR became an extremely busy railway in the 20th century and proved invaluable during the two world wars. After 2 July 1905 trains mostly ran between Dingle and Seaforth & Litherland. Despite being a very busy railway that easily covered its operating costs, in the 1950s the overhead structure on which most of the line was carried was found to need major repairs and the LOR company did not have the capital funds that were needed. Despite much local protest the LOR was closed on Sunday 30 December 1956. The last train to leave Dingle did so on the afternoon of the day after closure. It was a staff train that ran to Seaforth Sands.

Demolition of the LOR began on 23 September 1957 and it had been completed by January 1958. After the demise of the line Dingle station was used as a rope works and then as a car repair garage which passed to Roscoe Engineering in 1977. The platform had been

removed during the rope works era and office buildings had been built on its site. A ramp had been constructed in the garage era which allowed cars to drive down into the tunnel via the former pedestrian subway. Despite these alterations many features from the LOR era survived including buffer stops at the end of the head shunt tunnel. Employees of Roscoe engineering also found many items over the years such as insulation pots from the live rails and an LOR train axle box. The items were given pride of place within the garage.

The extent of the tunnel roof collapse is clearly demonstrated by this view. Despite the multi layers of brick that form the tunnel structure they were unable to withstand the pressures that occurred during the very wet Spring and Summer of 2012

On 24 July 2012 there was a catastrophic collapse of the tunnel roof within the station during the daytime when the garage was in use. Hundreds of tons of material fell into the tunnel. Roscoe Engineering staff were having a tea break at the time and fortunately nobody was injured but some cars were destroyed by the fall. Eleven properties that were located above the tunnel became unstable and their occupants had to be evacuated.

The spring and summer had been exceptionally wet and it is believed that this was a contributory factor that led to the collapse. As has been mentioned the station tunnel had been built using the cut and cover method and loose fill material had been used to cover the tunnel over once it had been built. This was very evident from the material that fell into the station site at the time of the collapse. The collapse led to concerns about the rest of the station tunnel the other tunnels of the LOR southern extension. They included the half-mile Dingle tunnel that connected the station to Herculaneum Dock and a short head shunt tunnel that was used for reversing trains. The other tunnels had been cut through the sandstone ridge that rises up to Dingle from the banks of the River Mersey and they were found to be sound. The rest of the station tunnel also appeared to be in good order.

The site of Dingle station looking towards the end of the line. The supporting structure can be seen in the background. The tunnel running through it to the left gives access to the ramp that leads up to street level. The tunnel to the right gives access to the rest of the station site

Progress on arranging a repair was slow and led to many complaints especially from the affected residents who could not move back into their homes. This was due to a number of factors including debates as to who was actually responsible for the ground above the tunnel. There were also issues of safety with regards to anyone entering the tunnel and discussions as to how the repair might be affected.

The repaired tunnel looking west from the approach ramp. The concrete structure that now supports the roof at the point of collapse dominates the view but does not detract from the overall design of the Dingle station tunnel

There were during this period suggestions that the tunnel might simply be filled in, a prospect that would have been very sad for such an interesting and important surviving piece of the much loved LOR.

After much legal wrangling a deal was brokered by the Liverpool City Council and a specialist engineering firm, SES Contractors, was appointed to carry out repair works. Work began on 8 October 2013, over a year after the collapse. Affected local residents were still living in hotel accommodation at this time. Work to make the tunnel stable took twelve weeks

and families were finally allowed to return to their homes in February 2014.

The tunnel was made safe through the construction of a concrete infill section that was built directly under the collapsed section propping up the roof. Through the concrete infill two tunnels were created so that access to the site was maintained. One is located at the bottom of the ramp that was built in the garage era and the other is at the point where the former down line (Seaforth direction) line had been. Whilst being a massive piece of engineering and a large supporting structure it does not look too out of place and it has meant that the Dingle station tunnel has been saved for posterity.

The material that fell into the tunnel is still present having been moved to the western end of the station site. Within the Dingle tunnel there are a number of cars that have simply been parked up there and forgotten about. The oldest date back to the 1960s and they arouse much interest amongst classic car enthusiasts.

Although the repair has now been carried out, what has not been decided is what will happen to the site in the long term. The owners Roscoe Engineering will not be moving back in as the cost of insuring the site would now be prohibitive. It is unlikely that anyone would want to purchase the site as its uses are limited. The City Council is facing budget pressures and would not wish to take on something that could be a future financial liability.

A view looking east at the Dingle station site after the repair had been completed. The concrete supporting structure can be seen in the distance. In the foreground is some of the material that fell into the tunnel

All photos by Chris Isles

Meet the Committee – Tim Wellburn

I joined SubBrit in late 2007, having been hooked by copies of *Subterranea* that Clive Penfold brought in to Kew Bridge Steam Museum – now the magnificent London Museum of Water & Steam, where I have long been a volunteer and Trustee.

I cannot explain my fascination with things underground – and rarely attempt to do so (my family and non-SubBrit friends tolerate it as a *largely* harmless eccentricity). But it fits admirably with my long interest in industrial archaeology – and the seeds of both may lie in surface explorations of Welsh slate mines many decades ago. It also dovetails splendidly with my interest in fortifications, where I'm happiest exploring the subterranean depths of an *ouvrage*, a long-abandoned caponier or counter-scarp gallery. My other interests include most forms of transport, although I prefer terrestrial ones to be steam-powered and airborne varieties to be aerobatic.

I'm fortunate to have had two transport careers – and now to be retired from both! Having spent many happy hours being paid to fly Chipmunks with my University Air Squadron, I joined the Ocean Steamship Co, sailing to the Far East on the penultimate voyage of one of Blue Funnel's magnificent traditional cargo liners. I then changed mode to airfreight, subsequently spending some 7 years working in Singapore and Hong Kong (with the bonus of some exhilarating flying with the RHK Auxiliary Air Force). This was a period of extensive travel: my suitcase was always packed against short-notice business trips, but we also managed to fit in quite a few exotic holidays!

After returning to the UK about 1990, I took a year off to do an MBA at Cranfield: the most sustained period of high-pressure activity I have ever experienced. From there, I entered the Civil Service to work in transport policy: successively aviation, shipping, logistics and railways. My last responsibility was to develop a national rail infrastructure strategy: essentially specifying the Government's shopping list for upgrading the network over the next decade and beyond. A seriously expensive train-set!

As a Committee member, I hope to be able to contribute to SubBrit's continuing success.

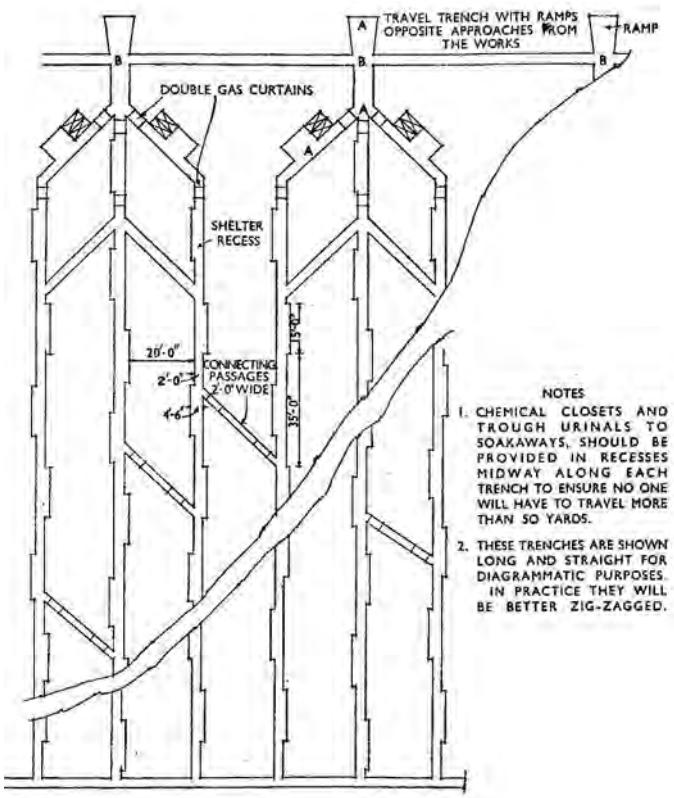
Early Factory Air-Raid Shelters

Chris Rayner

The Gourock Ropeworks at Port Glasgow. The end bay of the shelter was curved towards an access point from nearby tenements where employees' families would have lived. The ventilation duct is quite narrow in diameter here, the furthest point from the fan motor. Below it was a continuous concrete-lined duct which may have been for drainage

Businesses were first called upon to provide air-raid shelters for their employees during the summer of 1936, but with no financial support offered from central government and with the dangers uncertain most would have felt little urgency in acting. The Home Office handbook "Air Raid Precautions in Factories and Business Premises", first issued in November 1936, was however widely read by business owners, as well as by the wider public, as it was the first official guidance on shelter design and everyone wanted to see what they might be in for.

The handbook reflected the government's enduring attachment to a policy of dispersal. Employers were urged to send staff home during raids if they lived within five minutes' walk of the workplace, revealing a highly misplaced confidence in the enemy's ability, not to mention intent, to carry out precision bombing. That this policy of delayed dispersal was not as unpopular


TRAVEL TRENCH WITH RAMPS OPPOSITE APPROACHES FROM THE WORKS
RAMP
DOUBLE GAS CURTAINS
SHELTER RECESS
20'-0"
2'-0"
4'-6"
CONNECTING PASSAGES 2'-0" WIDE
15'-0"
35'-0"
NOTES
1. CHEMICAL CLOSETS AND TROUGH URINALS TO SOAKAWAYS, SHOULD BE PROVIDED IN RECESSES MIDWAY ALONG EACH TRENCH TO ENSURE NO ONE WILL HAVE TO TRAVEL MORE THAN 50 YARDS.
2. THESE TRENCHES ARE SHOWN LONG AND STRAIGHT FOR DIAGRAMMATIC PURPOSES. IN PRACTICE THEY WILL BE BETTER ZIG-ZAGGED.

The earliest government advice on air-raid shelter design given in the 1936 Home Office handbook "Air Raid Precautions in Factories and Business Premises" included this plan showing a galleried shelter

as one might imagine is borne out by a survey from a Leicester factory which revealed that over two-fifths of their 3,500 strong workforce would prefer to go home once an alert was given.

However for those other workers who stubbornly chose to live further away, employers were advised to provide workplace shelters either in basements, strengthened rooms at ground floor level, or outside in specially built trenches and tunnels described as "galleries". The handbook went on to give detailed guidance, much of which would remain unchanged for the next few years.

Some very basic and enduring principles included size limits on shelter subsections, which were to be limited to fifty people; construction was to be splinter-proof rather than bombproof with technical guidance on how to achieve this; entrances had to be protected with traverses and be gas-proofed, with guidance on how to build a simple gas lock; and shelters had to have secondary escapes. There were also detailed specifications for trench shelter construction and roofing, with dimensions for trenches, revetments, benches and bunks, and chemical toilet spacing.

Employers were reminded of the economic benefit of protecting their workforce, both within the handbook and during face-to-face meetings with government advisers starting in 1936, as the government sought to apply moral pressure in the absence of any financial inducements. There would be no compulsion to build shelters for another couple of years, but as we will see, many companies did start early, particularly where they were either engaged in, or expected to be engaged in military production, perhaps anticipating that they might be early targets in an aerial war that could start without any warning.

At the same time the government was making plans for "shadow factories", dispersed sites which would shadow production of vital aircraft components and later other military materiel, to ensure that for every product there was always a backup plant in case bombing took one out. These were built or acquired by the government with the agreement of a selected business enterprise which would then manage the factory, often making a military component somewhat removed from their peacetime experience. Some of these shadow factories included heavily-protected production areas, although manufacturing underground, despite the advantage in terms of lack of disruption by bombing, was generally ruled out due to the massive cost.

Factory shelters become compulsory

Many businesses though had still done nothing by 1939 when the Civil Defence Act at last made ARP compulsory for "occupiers of factories and owners of mines and commercial undertakings" and a building code was issued which gave specific advice and examples.

One of the problems faced by management in choosing shelter locations was the lack of open space well away from buildings that could fall on them, and from dangerous plant processes and heavy machinery. In such cases they might be allowed to extend under adjacent roadways, as theoretically happened at the Player's cigarette factory in Radford, Nottingham, although no traces of access from the factory's basement were found during a thorough search with the new owner several years ago. Modern steel or concrete-framed structures were at an advantage in such cases as they were less likely to collapse under bombing than older masonry structures, allowing trench shelters to be built close by or even inside them.

Many industrial sites were spread out over very large areas though and needed often widely dispersed shelters to protect staff wherever they were working. Isolated shelters sometimes have survived where other traces of an industry have gone; thus for example the Pincroft Dyeing works shelter at Adlington in Lancashire looks in better shape today than the ruined riverside mill it was built for, while the lost Cosmeston Snowcem cement factory is only marked by some overgrown air-raid shelters in a thick copse in Lower Penarth, south of Cardiff.

Entrance to the shelter in Lower Penarth

Cement workers also appear to have been the beneficiaries of the shelters that served the Alpha works at Salt Lane in Cliffe, near Rochester, while quarry workers may have used or reused the tunnelled shelter in the quarry face at Chafford, Essex. Reused quarry workings provided a convenient low-cost option for companies like the Thompsons Tin and Metal Works in Norwich, where the tunnels still retain traces of wartime strengthening, toilet cubicles and even a metal bunk.

Within buildings, the risks inherent in siting basement shelters under heavy machinery and water tanks were highlighted, advice that if heeded could have saved many lives, such as, most infamously, at Wilkinson's lemonade factory in North Shields in May 1941 when an unlucky bomb resulted in the deaths of 105 people in the factory's basement air-raid shelter, crushed by falling machinery from the factory above. On that occasion the shelter was being used out of hours by members of the public; however an almost identical disaster at the Birmingham

A simple shelter in the quarry face at Chafford, Essex which may originally have been unlined and was then strengthened with brick piers and vaulted beams supporting a corrugated metal roof

Small Arms factory at Small Heath in November 1940 put back rifle production by several months when key workers were crushed by machinery in the factory basement shelter.

Confidence in the basement shelter there may already have been low as most staff members left for the protected external shelters when the alert was first sounded; however some had wanted to avoid the disruption and loss of pay and had kept working, only retiring to the basement when the bombs were falling and it was not safe to go outside.

That there were many such incidents calls into question the wisdom of using basements as shelters in factories, and surviving factory basement shelters seen in towns and cities throughout Britain may have only survived by dint of never having been bombed. The atmospheric basement shelter at Braime Pressings in Leeds seems to be a good case in point.

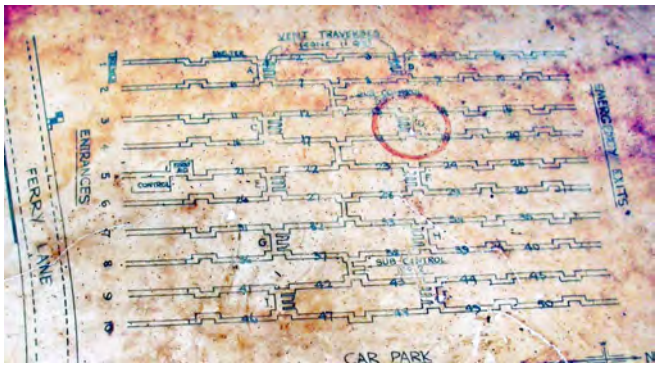
The shelter signage at Braime Pressings suggests the shelter was well thought out, which the flimsy wooden subdivision belies

The company had been started in 1888 to manufacture oil cans, and the buoyant market in pressed metal products had allowed them to build a new factory in 1911. Diversification into armaments manufacture in the First and more particularly Second World Wars saw the basement being brought into use as a shelter. The large red-painted shelter subdivision numbers and Ambulance Station (presumably First Aid Post) signage survive from this period and would have inspired confidence, though the perimeter pavement lights and lack of any internal solid blast compartmentation reveal its inherent unsuitability.

The Factories handbook included a notional plan of a large trench-shelter system with long root-like galleries linked by diagonal cross galleries. A note beside the plan reads “These trenches are shown long and straight for diagrammatic purposes – in practice they will be better zigzagged”, but this did not save it from unfair misinterpretation and ridicule by critics of the government’s shelter policy. The herringbone arrangement shown does not appear in surviving shelters, which may be in part due to the reluctance of most business owners to build shelters in 1936 – however a large interconnected set of tunnels over 2.5km long in Tottenham in north London had some similarities.

Harris Lebus factory in Tottenham

1939 photograph showing construction workers inside the completed tunnel. Photo from Oliver Lebus



Original plan of the shelter network which was found underwater in the circled toilet traverse, where it had been fixed onto a plywood end panel that had later collapsed and been submerged. Photo from CgMs Archaeology

Tunnel shelters were built in 1938 by the Harris Lebus furniture company beneath former allotments adjacent to their furniture factory in order to provide protection for their 3,000-strong workforce who were soon to be

engaged in military aircraft production. The firm had been heavily involved in war-related production in the First World War, when they had produced ammunition boxes, tent components and trench-digging tools, but now there was also the added likelihood of being a bombing target to plan for.

The network consisted of ten staggered linear shelters arranged in parallel pairs, and had a pleasingly simple plan symmetry which would not have been apparent on the ground. Each had its own ramped entrance at the south end and escape shaft at the north, while transverse passages either led to shared toilets or connected all ten tunnels together. There were gas-tight doors at the entrances; however unfiltered mechanical ventilation was only introduced at a later stage, the original intention being that there would be enough air for the short periods of up to three hours that occupants were expected to be in the shelters.

The shelters were lined with parabolic panels of precast concrete fixed in opposing pairs within a rectangular timber-shuttered trench that may have been dug in an earlier phase. The resulting shape made creating toilets, and later on spaces for bunks, more complex, but the shape would have had greater strength than the more common square or rectangular section shelters.

There were also First Aid and Control Rooms, both built out of mass concrete and cuboid in shape, the latter having a lookout post above it possibly to allow a shelter marshal to monitor the bombing, and inform shelterers via the built-in speaker system when it was safe to return to work before the All Clear was sounded.

A pair of toilet traverses are visible on the left hand side while beyond, a pile of stored duckboards reveal a history of water ingress. Photo from CgMs Archaeology

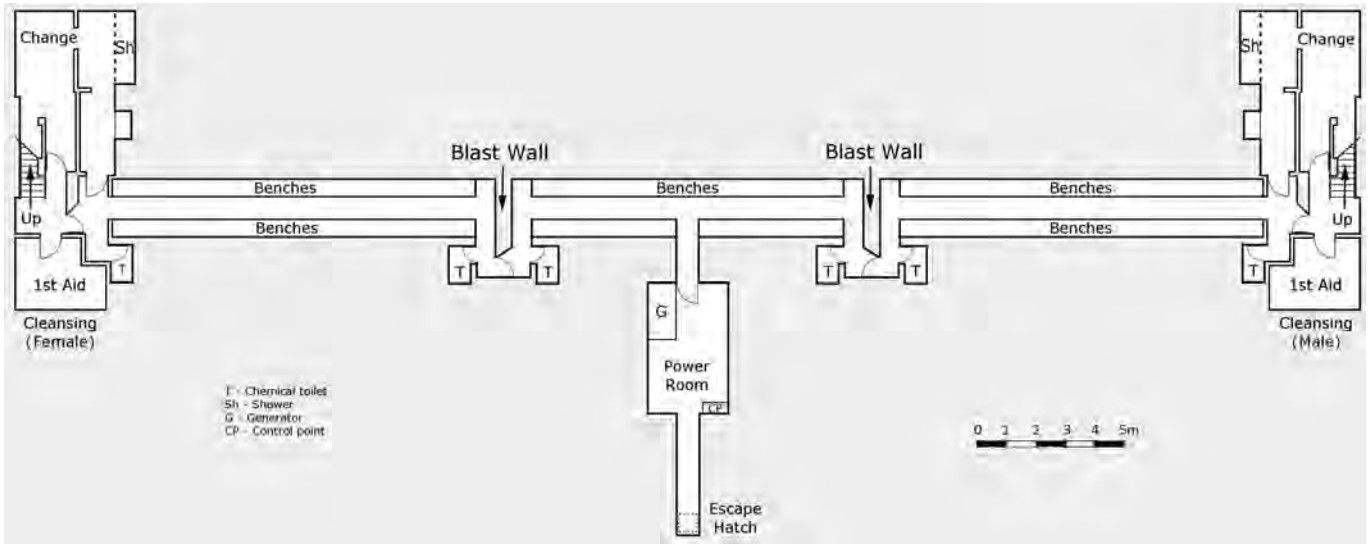
Toilet traverse tunnel, with toilet cubicles formed by posts and now absent privacy curtains. Timber seats conceal chemical toilets. Photo from CgMs Archaeology

Sir John Anderson, the Minister of Home Security, officially opened them in August 1939 and declared that “of all the industrial establishments I have visited none has impressed me more than this one”. This is surprising as the system had some surprising deficiencies. Water ingress seems to have been a problem early on and despite post-construction attempts to apply water-resistant tanking, duckboards were needed and latterly the complex was flooded. Laying the floors at a slope to fall to sumps would have been a simple precaution but was overlooked.

Their most fatal flaw however was that they were too far away from the factory and it was found that alerts lost too much production time, time that could not be afforded when the factory was making aircraft that were vital to the war effort, and as a result they were abandoned in favour of new shelters built closer to the factory. Not wholly abandoned though, as they appear to have discovered a new role as a night-time shelter, possibly for the families of staff members. Bunks were brought in, halving the capacity of the shelter but in the process doubling the length of time the shelter’s air supply could last.

Boots the Chemist

Boots favoured the opposite approach of dispersed shelters, and at their large site at Beeston, near



Plan of the Ekco main shelter. Drawn by Nick Catford after Essex County Council Field Archaeology Unit

Nottingham, built a total of 42 external and 34 internal shelters in addition to many more fire-spotter posts, first aid posts, rescue posts and decontamination posts, altogether staffed by 872 volunteers. The company was another that had had experience of being a vital part of the war effort when they had filled the gap left by the loss of German pharmaceuticals during the First World War. Two decades later a new war brought new challenges, and Boots' input would include manufacturing anti-malarial drugs for soldiers fighting in the Far East as well as the miracle new drug, penicillin.

A shared rear entrance provides access to two mirror image shelters

Many of its shelters were cut-and-cover type, and an archive photograph shows some of these, laid out in a neat grid regularly punctuated by escape shafts. One group of surface shelters on their site though is particularly odd. With their curved entrance passages, thick board-marked concrete walls and flat concrete roofs which appear to float above a continuous layer of clerestory windows, there is more the look of a Brutalist art gallery from the 1960s than something built three decades earlier. They certainly do not look like air-raid shelters, even if they were, as some records suggest, part-buried originally.

Curved entrances would be later seen in the Finsbury deep shelter proposals in London but it is lucky that neither was put to the ultimate test as they were considered by the Hailey Conference to be ineffective at diminishing or deflecting blast.

The interior of the shelter with its sloping upper walls and architectural floating roof illustrating the danger of putting appearance and future use before basic functionality. As intended, after the war the shelter saw use as a bike store, the wheel attachment rail of which survives

The structures are very early – one construction photograph is dated July 1937, suggesting they were planned in 1936. Boots were undoubtedly ahead of their time and had been congratulated by Home Office technical staff for their "model shelters" even before the Munich crisis. The clerestory windows though are a problem as they run completely counter to the principles of blast and gas protection, but another picture in the company archives sheds some more light. It shows an almost identical shelter filled with bikes, and reveals the intention of the shelter's designers to build something that would be useful in the postwar world. So while London architects like Tecton were planning the enormous deep shelters at Finsbury that would be reused as peacetime underground car parks, the architects at Boots had a more modest and achievable ambition, a bike shelter whose clerestory windows would have been sandbagged during hostilities.

E.K. Cole, Southend-on-Sea

A great deal of originality went into many of these pioneering shelters built by companies that would go on to play an important part in the coming war, and may

have been a natural by-product of their employment of particularly gifted people with technical design expertise. The Ekco factory at Southend was a pioneer in the mass production of radio and television sets in the 1920s and was already working on secret projects including the development of radar in 1937, their work being of such importance that MI5 agents were infiltrated into the workforce to check against espionage and sabotage.

The increased intensity of work required new factory buildings, and at the same time three underground shelters were provided. One of the shelters though was built to a much higher specification than its neighbours as it was intended to house both management and also key personnel in the radar and design teams, the latter of whom would work on special trolleys that could be brought more easily into the shelter during alerts.

The centre gallery was divided into two by the access door to the power room. The bayonet light fittings were purpose-designed to resist damage during a raid. Photo from Essex County Council Field Archaeology Unit

Even the filtered air inlets were purpose-built and very distinctive. Photo from Essex County Council Field Archaeology Unit

Entry was via gas-sealed Dreadnought blast doors leading down to gas decontamination showers and first aid facilities, and thence to three blast-separated 50-person shelters built using 2.0m diameter precast concrete pipes. The shelter had its own power supply, drinking water services and filtered mechanical ventilation, and the whole design has a scientist's attention to detail. Some features though are very odd, such as the segregated male and female decontamination entrances suggesting that men and women worked in separate areas of the factory. There were also unusual locking arrangements with spy glass protection suggesting that the shelter could go into lockdown, though whether to protect occupants from enemy commandos or less privileged employees is unclear.

Ropeworks, Gourock, Scotland

The Gourock Ropeworks at Port Glasgow was another unusual factory shelter that could once have housed up to a thousand employees and family members. A newspaper report in May 1939 called the shelter, built by the Birkmyre family for their mill workers, "the largest of its kind in the country". It had been built at a cost of around £7,500 by a team of Polish workmen, and was over 200m long and around 14m below the surface. Its structure resembled shelters built by the Royal Engineers in the Southeast, with corrugated-steel arched roofs supported on colliery hoops, the quasi-military form of construction possibly because of the mill's important ropemaking work for the Navy.

One of the two narrower access tunnels from the factory which was used for storage after the war and appears to have been damaged by a fire at some point

At the opposite end from the families' entrance was a brick-lined tunnel with more Elsan toilet cubicles. Brick lining may have been used at this point because the tunnel was very close to the surface

It had four tunnel approaches, two of which came direct from the factory, while the other two were for employees' family members who had been issued with passes to

allow them access in any periods of alarm. Getting into the shelter, though, was not always easy as there could be throngs of "strangers" around the entrances also trying to get in, some using counterfeit passes, and during the May 1941 blitz the police had to be called to prevent a crowd of several thousand people trying to get in.

Courtaulds in Essex

Dual use by workers' families may also have been in mind when the row of fifteen 50-person trench-shelters were built near to the Courtaulds synthetic fibre mill in Halstead in Essex as these are so close to employees' houses. Lined with vaulted precast concrete and neatly aligned like corpses on the sloping ground to the north of the mill, the eight-metre-long shelters have entrance steps at one end, steel blast doors, and a laddered emergency escape at the other, the latter awkwardly positioned in front of a pair of narrow doors marked "M" and "F", screening-off chemical toilets.

The escape shaft of one shelter with the entrance of its neighbour behind it – these are separated by the regulation minimum distance of 25ft. Workers' houses in Factory Terrace are visible in the background

Littlewoods, Liverpool

Long shelters with multiple entrances facing exit routes from the parent factory were a familiar approach, as seen at the Littlewoods' factory shelter in Liverpool which runs parallel to the rectangular factory building along the banked east edge of Wavertree Park. This was seen by members at the SB Autumn Visits' Day in 2012 and described in *Subterranea* issue 30.

Henley Telegraph, Kent

The Henley Telegraph Works, beside the Thames at Northfleet, was fortunate in having a much taller vertical bank, a former chalk quarry wall, at the back of its site allowing it to tunnel into and provide well-protected walk-in shelters. These were an essential requirement for a company involved in war production on the banks of the Thames, a location that was so heavily targeted that it was referred to "Bomb Alley". Henley's production of degaussing components was essential for protecting ships from German magnetic mines and would have made them a prime bombing target.

Looking along the main spine towards the shelter entrances which were at a slightly lower level, helpful for drainage and washing down

Proof that you can get piles from Elsans

The grid of tunnels they built in 1939 was accessed via six portals, each with an offset entrance for blast protection. The interior is unusually spacious and architectural, and the neatly shuttered concrete lining suggests work of high quality. Surviving painted signage refers to seating which would probably have been provided by loose benches, for today the only furniture remaining is a collection of Elsan toilets in one tunnel recess.

Remains of a gas filtration plant shows this to be an early shelter and unusually progressive. It is not known how many people could have sheltered inside, for although the company had 2,000 employees, due to shift work they would not have needed to shelter the whole workforce at once.

Shorts of Rochester

The Shorts Seaplane Works at Rochester was on another spread-out riverside factory site, in this case the much narrower Esplanade beside the River Medway, onto which they had a slipway for launching their seaplanes. This had been Shorts' main factory site since 1914 and prior to the Second World War they built a long linear network of tunnels within the raised chalk riverbank at the rear of their premises. These would later be extended to the south once the Blitz started and the Ministry of Aircraft Production approved construction of a pair of large protected chambers, 100m long and mechanically ventilated, for use as workshops. The overall length of

the finished complex was over a kilometre. Regular entrances and escape shafts were provided, and the complex included a well, a hospital, and several secure storage vaults often misidentified as cells.

After the start of the Blitz in autumn 1940, Shorts were given permission to excavate two large brick vaulted workshops at the south end of their shelters to allow work to take place protected from bombing

The original air-raid shelters and vaults were visited by the King and Queen in March 1939, a newspaper report recording how... “at one point in the tour the King and Queen walked far into the catacombs driven into the hill behind the works. These underground passages, from 60 ft to 300 ft under the surface, serve as the air-raid shelter for all the thousands of employees. The figure of the Queen, dressed in a violet costume and hat trimmed with fur, was watched by many of the workpeople as it passed deeper into the well-lit burrow and at last vanished round a bend far into the heart of the hill.”

Passage crossings at Shorts in Rochester required a change from the normal corrugated steel vaulted roofs to rendered ceilings on steel and timber joists which are now the weak points in the complex

Construction of the air-raid shelters and access tunnels was both simple and relatively strong, comprising a calcium silicate brick wall, with vaulted corrugated sheeting above covered by a layer of concrete. Tunnel crossings were the weak point and the original flat rendered ceilings have largely fallen today, exposing a framework of rusting steel beams and rotten timber joists above. The post-Blitz factory end meanwhile has large brickwork vaulted chambers.

Photos by Chris Rayner unless stated

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Wartling progress report, Sussex

John Smiles

One of our regular helpers, Dom Jackson, getting to grips with our digger in July 2015. Photo John Smiles

SubBrit members have been involved with the work at Wartling ROTOR radar bunker for many years since first pumping out the flooded site in 2004. A small but dedicated team of volunteers works to best preserve what remains, primarily by a) stopping any more water getting in, and b) speedily ejecting any water that has bypassed our best efforts at implementing a).

Removing water from the bunker has been made harder for some time due to the sub-par electricity supply available in the bunker, fed from an inadequately sized cable from the nearby Radar House (the former Type 80 radar modulator building). The result of this is that although the bunker is nowhere near as flooded as it has been in the past – up to nearly the top of the lower level – there has however been 42cm of water recently, making most of the ground floor inaccessible.

Our last working weekend in July 2015 saw a group of bunker enthusiasts gathering in Sussex for three days of work to install a new 8kW power supply to the bunker from Radar House, approximately 100m away. This involved hand-digging a trench inside the borders of Radar House whilst keeping the tenants happy, machine-digging the trench to the bunker, installing a new higher capacity armoured cable, making connections at Radar House and the bunker, and finally testing and commissioning the new supply.

In addition to this, a flange has been fabricated so we can connect our modern pumps up to the original sewage ejector piping, which terminates in a covered concrete pit further down the field. The benefit of this isn't just tidy disposal of the water (i.e. not staining the field above with rust) but, with the pipe being deep underground, it also saves a significant head of water that we don't pump. This makes pumping much more efficient, and cheaper to boot.

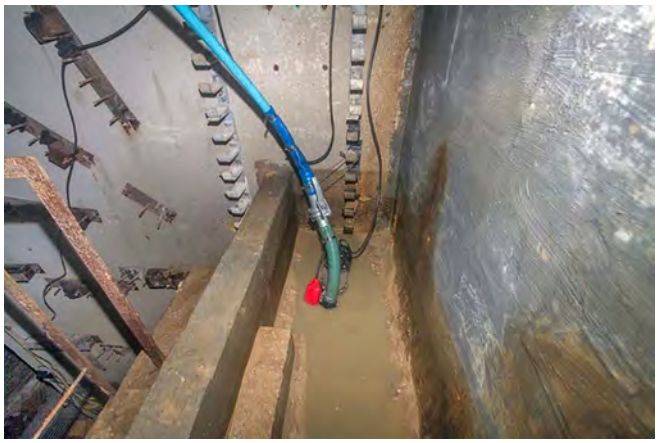
Our new drain, the settlement tank of the ROTOR period sewage farm. Photo Bob Clary

Richard Savage's handiwork, a new flange to repurpose the original pipework. Photo Martin Lulham

With the new power supply running all-new pumps through our shiny new connections, it was possible to reduce the water level downstairs from over 40cm to marginal levels in just days. This meant we exposed the sump for the first time in forty years. This work was followed up rapidly with the installation of automatic protection pumping at both ends of the bunker.

This means that the structure is now effectively secured; no more water should ever reach the lower levels so long as we pay our electricity bill. In turn this will allow us to properly clear these rooms of debris and sludge so visitors can stand in the only surviving original ROTOR Ops

Richard and John Smiles manhandle the large steel cover out of the way to allow us to drop a modern pump into the original sump, the lowest point in the building.
Photo Chris Howells



A new automatic pump in the dam we built at the top of the cable shaft, the haphazard demolition of which caused the leak that filled Wartling with water in the first place.
Photo Chris Howells

Room and admire the remains of the tote board, control cabins and period floodlighting.

A number of other works were also completed:

• David Heyes and Howard Rackliff (agri fitter and RAC Man respectively) repaired our hire digger which refused to run for more than a few moments, thereby saving the weekend's planned works

• Re-rendering the blockhouse / vent stack of the original Emergency Exit as the render has badly failed causing the underlying bricks also to fail

• Excavating the area around the emergency exit to seal and waterproof the old cable-entry ducts which were our biggest leak

• Fixing new galvanized metal flooring into place to allow safe access to all parts of the bunker, replacing the original teak that was robbed out years ago

Photo above right Martin Lulham

We'll all be back again soon and have a massive task list that will keep us happily noodling about in filth for the foreseeable future. The next big task is installing GSM-based telemetry and alarms system so that the status of the bunker can be remotely monitored.

Nigel Ostler-Harris breaking out salt-glaze pipe cable ducts ready for plugging and sealing. Last winter, the small holes through these ducts would run like a bath tap on full during rainy periods. Photo David Heyes

These works were only possible thanks to SubBrit, its committee and members for unstinting financial and moral support over many years. The flooring, pumps and building materials we used were all funded by a SubBrit grant augmented by individual donors.

Also thanks to David and Marian Harding, not just for allowing access to their property, but also for their hospitality in making us feel at home on work days (not least with the generous supply of Harvey's Best to make working in the sunshine so much more civilised).

Discounted Cotswold Shopping

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****

Here is an introduction from David Hague of Cotswold:

"Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field."

Sub Brit Forum : How to upload photos to the Forum

Linda Dixon

In the last issue of ***Subterranea*** (Issue 39, August 2015, page 24) we showed you how to stay in touch with Sub Brit events and news by getting the Forum to send you emails.

Here's how you can upload your photos to the Forum – one of the big advantages that the new Forum gives you over the old email list.

First, log on to the Sub Brit Forum (a reminder below).

To start a new thread, then click '+ New Topic' in the top right of the screen, and give it a title.

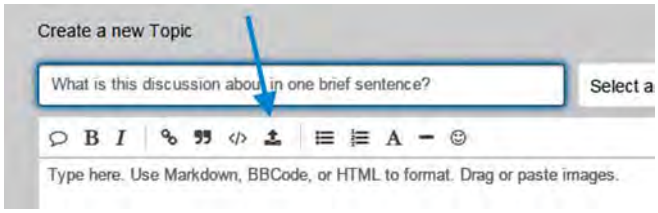
To add to an existing thread, then click on the thread and click on 'Reply' at the bottom of the thread.

You'll get two boxes on the screen : type in the left hand one to introduce your topic – the right hand box shows you how it will be displayed.

Now to attach your photos, there are a number of icons across the top of the left hand box – click on the one with bar at the bottom and an upwards arrow.

The next panel allows you to find your photos. Click on the 'Choose files' button (if the photos are on your PC/device) or click 'from the web' if they are on the cloud somewhere. Then locate your photo(s).

Once you've done that, then click 'Upload' at the bottom left of the box on the screen. It will take a while to upload the photos. If you want to add labels to the photos, then it might be better to do them one by one.


Create a new Topic
What is this discussion about in one brief sentence?
Select a
Type here. Use Markdown, BBCode, or HTML to format. Drag or paste images.

When you've finished click either '+ Create Topic' or 'Reply' in the bottom left-hand corner.

Good luck!

How to log on to the Forum – a reminder

* Go to https://my.subbrit.org.uk/
* Log in using your mySUBBRIT credentials (username and password).

If you've forgotten your password, then use 'Request new password'

* Click 'Access member forum' on the menu.

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